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THE DECORATED GARDENS OF CHICAGO.

WE give some views in Washington Park, Chicago, which forms part of the site of the great exhibition. The following remarks are from our French contemporary *L'Illustration:*

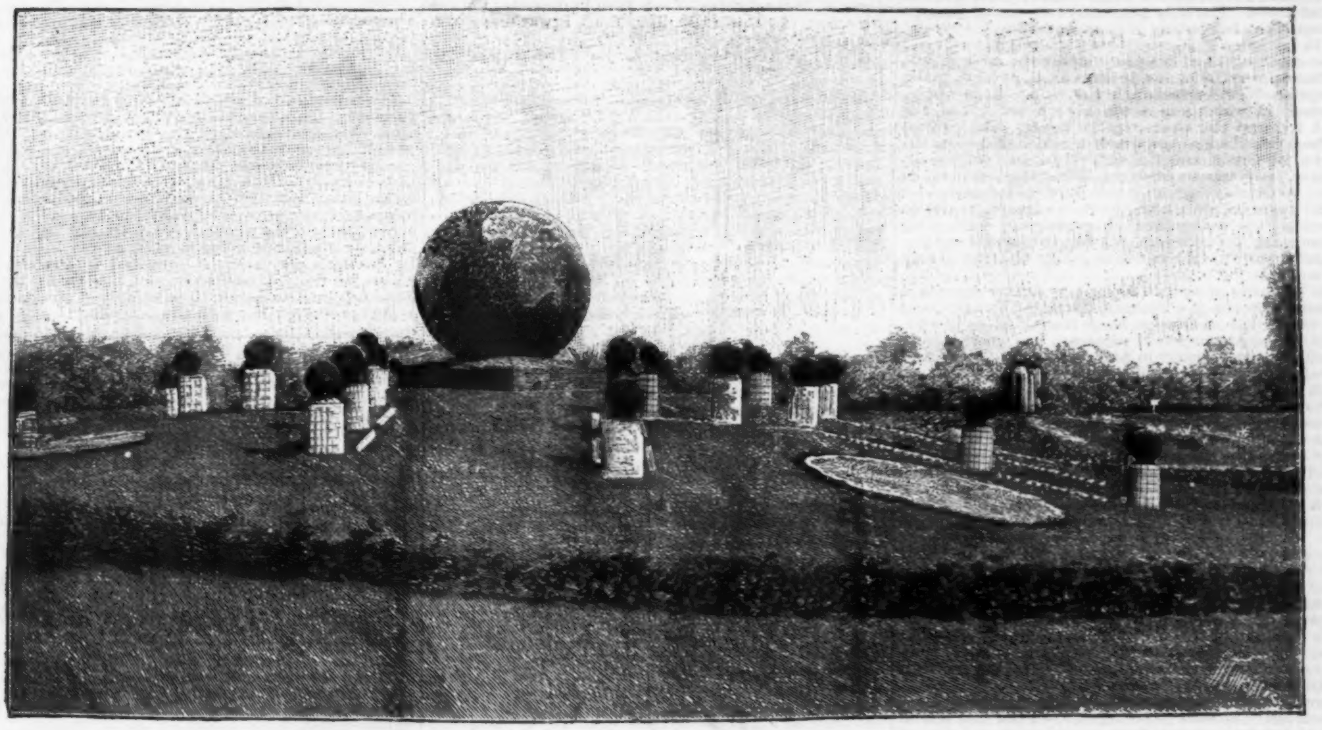
The Americans have for some time past adopted for their public gardens a mode of decoration which is not without originality, although it is, after all, an amplification, in a manner, of what we are doing right along.

It is well known, in fact, that by means of plants with various colored foliage, planted alongside of each other, our horticulturists obtain very curious semblances of carpeting.

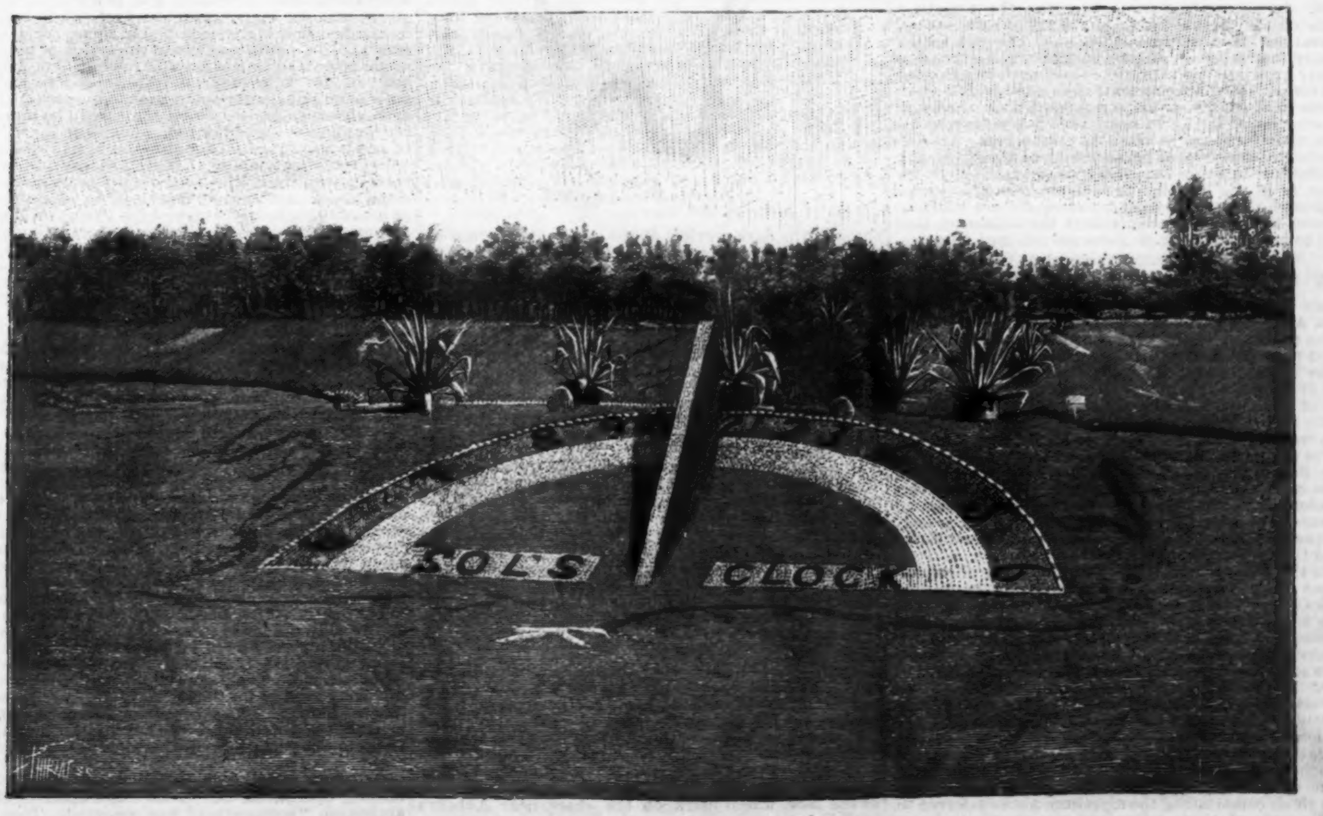
They depict in this way, upon the greensward of a lawn, stars or groups, or imitate animals and signatures of celebrated men, or write entire distichs.

It is useless to dwell upon these conceits, as they are known to all.

The Americans call these decorated pieces of ground broidered gardens, and in this respect the Chicago parks contain the masterpieces of the kind. We give herewith two specimens, one of which represents a sun dial and the other a terrestrial globe. They are formed simply of a metallic framework of iron outlining the object that it is desired to represent, and which is



THE FLORAL GLOBE, WASHINGTON PARK, CHICAGO.



THE FLORAL SUN DIAL, WASHINGTON PARK, CHICAGO.

firmly set into the earth, or on a pedestal if the object (like the globe, for example) is to be supported in the air or stand out from the ground. In the calculated intervals of this frame are inserted flower pots containing plants of various colors. The effect is very original.

THE CRACKING OF FRUITS AND VEGETABLES.

The cracking or bursting of fruits and vegetables during growth or at maturity is often a source of considerable loss. A better understanding of the causes of this trouble might enable us in some cases to use preventive measures. At present it must be confessed that the subject has been too little investigated. It is plain that all instances of cracking cannot be referred to a single cause, and it is quite possible that in some cases the real source of the affection has not been suspected.

In certain vegetables, as the carrot and kohl-rabi, as well as in the potato-tuber, the cracking appears to be the result of a second growth that occurs after some maturing of the tissues has taken place. When a period of dry weather, which tends to premature ripening, is followed by abundant rain, a new season of growth often begins. But the outer layers of cells being no longer capable of growth, the formation of new cells in the cambium region of the vegetable or tuber necessitates a rupture of the outer part, precisely as the formation of a layer of new wood causes ruptures in the bark of trees. The only preventive we can at present propose is the harvesting of the crop before the second growth has gone sufficiently far to cause the rupture.

The cracking of ripe apples upon the tree in wet weather appears to be due, in some cases, at least, to the absorption of water through the skin. Ripe apples immersed in water will often absorb enough of the liquid to burst the skin in a few hours. The process has been ascribed to an osmotic action between the juices of the fruit and the water. In an experiment, however, there was no evidence that osmosis had taken place. After soaking an apple in distilled water for several days, during which the flesh cracked nearly to the center, the water gave no evidence of containing glucose, and showed only the faintish acid reaction. The preventive in this case is to gather the fruit as fast as it matures.

The cracking of apples and pears during growth is generally due to the fungus parasite (Fusicladium) that causes the scab upon these fruits. It is, indeed, the advanced stage of this disease. The preventive is to spray the trees early in the season and at intervals thereafter with a solution composed of one and an eighth ounces of copper carbonate dissolved in one quart of aqua ammonia and diluted with twenty-five gallons of water.

The cracking of ripe tomatoes in wet weather is probably due, as in the case of ripe apples, to the absorption of water through the skin. But tomatoes sometimes crack in dry weather and while still immature, which must be ascribed to another cause. Sometimes this appears to result from an unequal ripening of the fruit. In this case a circle of cracks forms about the stem, and the portion of the skin within this circle often remains green after that of the remainder has assumed the color of maturity. The growth of the ripening part proceeding faster than that of the remainder, a rupture takes place between the two portions.

The cracking of melons often seems due to a similar cause. The blossom end of the fruit ripens faster than the stem end, and the expansion of this part causes a bursting of the apex. This difficulty appears to be characteristic of certain varieties. In a large number of seedlings of crossed parentage grown the past season some of the fruits burst from the blossom end almost to the stem, and in some cases the parts curved backward as if the fruit were being turned inside out.

The tendency to cracking of the fruit is apparently due in some cases to a pathologic condition of the plant. In an experiment in breeding the tomato, a strain of the Cook's Favorite variety grown several generations from unripe seed formed the past season seventy-four per cent. of cracked fruits, while the same variety grown in the meantime from perfectly ripened seed formed only 25·3 per cent. of cracked fruits. Both strains were grown under equal conditions except in the selection of seed. In nearly all cases certain varieties are more subject to cracking than others. A difference in the elasticity or permeability of the epidermis, a difference in the absorptive power of the flesh for water, or of the liability to fungous attack, or of the tendency to ripen unequally, causes certain varieties to resist much better than others the influences that tend to cracking.—*E. S. Goff in Garden and Forest.*

THE MICROBE OF PHOSPHORESCENT WOOD.

The following is from a paper read before the New York Academy of Sciences by Dr. Alexis A. Julien.

The phosphorescence of wood has been often supposed to be connected with the green coloring produced by certain fungi, especially *Peziza Jungermanniæ* and *P. æruginosa*. On an examination of a large number of samples of such green decayed wood, collected in the Adirondack Mountains in 1889, not a single specimen was found to be phosphorescent; and this fact serves in confirmation of the similar conclusion of Ludwig, Zukal, and others. However, I have noticed, in some cases, that the cells may contain large numbers of micrococci, and that these may be actually colored green—by a natural process of staining, apparently unique in nature—by the green coloring matter diffused from the fungus through the woody tissue.

On the other hand, specimens of brightly phosphorescent decayed wood, recently obtained in the Adirondacks, were found to be uniformly uncolored. The cells were turgid with liquid, apparently in unusual degree, and contained the mycelium of a hymeno-mycetous fungus (as yet not identified), whose hymenia were scattered over the exterior surface of the decayed tree. The phosphorescent agency, however, was found in vast numbers of a microbe of micrococcous form, mostly spherical, of wide variation in size, from 0·2 to 3 microns or more in diameter. These were scattered, or gathered, in a variety of groups, diplococci, chains, bunches, etc., and even found sprouting out into rods, some of which passed into short articulated hyphæ, like those constituting the mycelium above referred to. The source of these micrococci was shown in larger oval sacs, 9 by 7 microns in length and breadth, apparently derived from the mycelial threads, some being found still filled with the micrococci of very small size.

On squeezing the liquid out of the cells of the wood upon thin glass covers, the latter were rendered phosphorescent. The organism refused to grow upon the ordinary culture media, though the fragments of phosphorescent wood could be kept in full vigor and brightness for two weeks in a moist chamber. The film of micrococci upon the dried thin covers was readily stained by campechian (Loffler's solution).

The general literature on the phosphorescence of fungi and of wood was discussed, from the papers of Dr. Robert Boyle in the year 1667 down to the more recent investigations of Ludwig, Fischer, Arcangeli, Patouillard, etc.

NATURE'S PERSEVERANCE.

The following diagram is that of a cane which was cut in Pennsylvania about half a century ago, and is now in possession of my brother. It grew from a white oak acorn buried about three or four feet deep under a stone pile in an angle of a worm fence on the southeast edge of a woods on a spur of Edge Hill ridge in Montgomery County.

The cane as given is with the bark off, and though but the usual length of a cane, three feet, the total length is seven and a half feet. The curious part is that Nature reversed herself, as the base of the trunk just where it was cut above ground, after removing the stone, is three-eighths of an inch in diameter; while three feet, perpendicular height up, it was only a sixteenth less than an inch.

It will be observed that in its difficult passages

through the dark crevices of the stone pile, it grew almost straight, with one small joint up fourteen inches, where it struck a flat surface. Then followed a gallery at right angles five and a half inches; from here it was obliged to trace its way directly toward the earth, slanting to the left ten inches down, where it filled up a space three inches across formed as the opening allowed, and then found its way off to the right, slightly upward, and so on its devious way to daylight. I have not the data for the height above the stone pile.

The photo does not give a correct idea of the twisting, as the point which appears to touch is some distance off, and twists itself in every direction within a radius of a foot and a half.

Undisturbed it would no doubt in time have gathered strength to shove the stone apart, like a curiosity I once saw in Illinois, that of a young tree growing out of the joint between the stones in the third story of a court house, which began to press the stones apart and probably had to be removed.

Another curiosity of a similar nature near here is a gravestone almost entirely embedded in the trunk of a large tree. It would be curious to know how long the tree was seeking the sunlight of heaven and free air.
—*Nature's Realm.*

The project of connecting England and France by a bridge or subway across the channel, is again attracting attention in London. A bill has been presented to Parliament for the construction of a submarine tubular railway, connecting the English and French railways, at Dover and Calais respectively. The proposal is that the railway shall consist of two connected tubes one for each line of railway, and that it will commence at the low water mark on the shore, near Abbott's Cliff Houses, and emerge on the French coast at Sandstone Cliffs, about a mile south of Cape Grisnez.

ALUMINUM STEEL.*

By R. A. Hadfield, Sheffield.

Having mentioned the principal methods of producing the metal itself, reference may be made to the already large employment of aluminum alloyed with copper, known as aluminum bronzes, for quite a countless number of purposes. It may be interesting here to state, as one of the first public notices, that in the *Morning Star* of May 21, 1862, considerable reference was made to the probability of aluminum bronze coming into extensive use. The many good qualities of these alloys will no doubt make the use of aluminum in this direction alone of very wide importance. The following table gives the range of tensile strength and density of these forged aluminum bronzes:

TESTS OF ALUMINUM BRONZES.

(*By John H. J. Dagger, in a paper read before the British Association*, 1889.)

		Tensile strength in tons per square inch.	Elongation.	Density.
			Per cent.	
Aluminum bronze	11 per cent. Al..	40 to 45	8	7·23
	10 " .	33 " 40	14	7·69
	7½ " ..	25 " 30	40	8·00
	5-5½ " .	15 " 18	40	8·37
	2½ " ..	13 " 15	30	8·69
	1¼ " .	11 " 13	55	....

The brittleness of alloys above 11 per cent. prevents their use. Those containing 60 per cent. to 70 per cent. aluminum are very brittle and beautifully crystalline; with 50 per cent. the alloy is quite soft, but under 30 per cent. the hardness returns. The 20 per cent. bronze has a whitish yellow tint, somewhat resembling bismuth, but is very brittle, and can be pulverized in a mortar. One of the most valuable properties of the alloys given in the above table is that of being forgeable and capable of being worked at red heat. Table B, having been specially prepared by Professor Tetmayer, of the Polytechnic School, Zurich, for the Aluminum Industrie Actien Gesellschaft, at Neuhausen, is given for comparison with the foregoing:

	Aluminum.	Tensile strength in tons per square inch.	Elongation.
	Per cent.		Per cent.
Aluminum bronze............	11·50	52	0·50
	11·00	44	1·00
	10·00	42	11·00
	9·50	40	19·00
	9·00	37	22·00
	8·50	33	52·50
	5·50	29	64·00
Aluminum brass............	4·00	45	6·50
	3·00	39	7·50
	2·50	34	20·00
	2·00	31	30·00
	1·50	29	39·00
	1·00	26	50·00

Professor Tetmayer has plotted his results, the curve obtained showing that with increasing aluminum content the tensile strength increases slowly at first, but then grows rapidly as the alloy is made richer in the lighter metal.

Alloys of Cast Iron and Aluminum.—As with other cast iron, aluminum cast iron, if it may be so termed, naturally comes under a different classification to that of the malleable compounds of aluminum and iron. Keep found that aluminum has, in a considerable degree, a similar influence to that of silicon upon cast iron, a fact strikingly confirmed in some special experiments of the writer relative to the action of aluminum upon combined carbon in spiegeleisen, and described later on. It is, however, only proposed to deal here with aluminum in its use in the manufacture of steel or steely compounds. There appears to be much misconception as to whether its employment is productive of good, and the author confesses that he believes that while the price remains so high, and except in certain special cases, its application does not seem likely to become large. Aluminum appears to be of most service as an addition to baths of molten iron or steel unduly saturated with oxides, and this in properly regulated steel manufacture should not often occur. Speaking generally, its *role* appears to be similar to that of silicon, though acting more powerfully. It must, however, be remembered that these experiments have been made with practically pure aluminum. If pure silicon were also obtainable, its effect would probably be found to be almost the same. So long, therefore, as ferro-silicon varying in silicon from 8 to 20 per cent. can be obtained at from £3 10s. to £10 per ton, as compared with aluminum or ferro-aluminum of like percentages costing £112 to £250 per ton, it will be seen that the probable field of usefulness for the latter must be much circumscribed.

CAST ALUMINUM STEEL.

Melting.—The material obtained for these experiments was produced by melting in crucibles, in the ordinary manner, good wrought bar iron, and adding the aluminum (about 98 per cent. of aluminum), manufactured by the Pittsburg Reduction Company's system, shortly before "teeming." Although a difficult one, the object was to obtain an alloy or compound consisting as nearly as possible of aluminum and iron alone. In the material made it will be found that the other elements present do not amount to more than 0·50 per cent., so that this intent may fairly claim to have been accomplished. The ingots, 2¼ inches square, were reduced by forging in the ordinary manner to bars 1½ inches diameter. The consideration of the qualities of these alloys is divided into two heads: first, the material in the cast; second, the material in the forged state.

Cast State.—Nothing special was noted during the melting operations, but in all cases upon adding the aluminum "coruscation" was observed. This evolu-

* Meeting Iron and Steel Inst., U. S. America, October 3, 1890.

tion of heat and light has also been observed when alloying aluminum with copper. Does not this tend to indicate that aluminum added to iron produces true compounds and not merely alloys, as it is well known in laboratory operations that the evolution of heat during the mixture of two substances is often a sign of chemical union? The curious properties of manganese steel seem specially to prove that such a material is a true compound, and no doubt aluminum steel may be classed under the same head.

Fluidity.—It is doubtful whether aluminum increases the fluidity of properly made steel, but if it does, the apparent increase or evolution of heat just referred to seems to the author far more likely to account for any increase of fluidity that may occur rather than the so-called lowering of the melting point. As the aluminum increases to large amounts over about 0·50 per cent., the metal becomes quite thick, "creamy," and sets quickly. No doubt this is partly caused by a considerable portion of the aluminum being oxidized to alumina and becoming entangled as slag, in the same way as occurs when silicon is oxidized to silica. Unless suitable flux is present, this excess of oxide cannot be carried off, the molten metal becomes fluid, and causes the "thickness" noticed. There is a resemblance in this respect to the action of high percentages of silicon added to iron. When exceeding about 0·75 per cent. of aluminum, the molten material so rapidly "creams" over on the surface that the production of sand-molded articles is only effected with difficulty—in fact, it was only by using considerable care that the cast test bars were obtained. (Keep, even with cast iron, found a decided decrease in fluidity by the addition of aluminum.) It must not be overlooked that the author is here referring to comparatively high percentages. So far as his own experiments have gone, aluminum, as regards lower percentages, also acts in a similar manner to silicon under the same circumstances. So much has been said as to aluminum lowering the melting point of iron that the author wonders how and why this statement was originated, as it certainly seems to have no foundation in fact. This is confirmed by Osmond, who by means of the "Le Chatelier" pyrometer (this *Journal*, 1890, 326) kindly made for the author a special determination as to the melting point for an alloy containing 5 per cent. Al and about 94½ per cent. Fe. The sample in question did not show the slightest signs of fusion until a temperature of 1,475° C. was reached. As mild steel by the same pyrometer was shown to fuse at about 1,500° C., there could therefore have been little or no lowering of the fusion point; and if this is the case with an alloy containing 5 per cent., still less can it be so with one containing only 0·10 per cent., which is the quantity usually described as being present when the so-called lowering point is supposed to occur. It is especially satisfactory to have the testimony, not only of Osmond (this *Journal*, 1890, 517 and 865) but that of H. M. Howe (this *Journal*, 1890, 946), who both agree with the author on this point. In the author's opinion, if any increase of heat or fluidity takes place by the addition of small amounts of aluminum, it may be due to either of the following causes, or to both combined. First, there may be evolution of heat owing to oxidation of the aluminum, as the calorific value of this metal is very high—in fact, higher than silicon. According to Berthollet, the conversion of aluminum to Al_2O_3 equals 7,900 cals., silicon to SiO_2 is stated as 7,800. This oxidation is probable, as in the writer's experiments the addition of aluminum to iron was always accompanied by more or less, often considerable, loss of the former metal. This is also proved by the fact of its appearing in the oxidized state in a white powder upon the side of the ingot mould, as well as in the slag; also from the fact that when small amounts are added they are rarely found in the product when being analyzed. In the 5 per cent. specimens previously referred to, the author found no less than 2 per cent. was wasted. Against the supposition that by oxidation increase of heat is obtained must, however, be placed the fact that when the aluminum exceeds say about 0·75 per cent., the less fluid is the product and the more metal is wasted; but at the same time the explanation first offered might still hold good as regards the lower percentages, say under 0·50 per cent. Secondly, and more probably, the correct explanation. As proved by Galbraith, the fluidity of molten iron and steel depends not only upon the amount of heat imparted by external means or by oxidation, but often upon the quantity of intermingled slag or oxide of iron (this *Journal*, 1890, 864, 865). He found that in certain cases in excessively over-oxidized steel, although the heat of the furnace was more than usual, the product was still lacking in fluidity. It would be interesting to have the point followed up and thoroughly tested by means of the "Le Chatelier" pyrometer. As supporting this, it may be observed that the well known German metallurgist, Ledebur, believes the *role* of aluminum "to be no other than that of destroying the dissolved oxide of iron present." That such over-oxidized metal possesses different properties as compared with ordinary steel or iron is very clear, for the author has had brought under his notice certain cases of over-oxidized iron which continued to rise, give off gases, and prove unsound in the ingots, notwithstanding the addition of even considerable quantities of aluminum. They are, of course, exceptional, and to the author seem to be explained by the facts pointed out by Galbraith. The loss of the metal in melting is variable, but in nearly all cases amounts to a considerable proportion of the percentage added.

The experiments prove that more aluminum may be present in the cast material than silicon in cast silicon steel before brittleness sets in. After reaching the region of brittleness, and by adding still higher percentages of aluminum, there is no return of strength, on the contrary; so that this material in no way resembles the curious property noted in this respect with regard to manganese steel.

Bending Tests.—The annealed samples up to 0·85 per cent. bent double cold; those unannealed were not so good. The gradual increase of aluminum is very clearly shown to reduce the toughness both of the unannealed and annealed specimens. They were sound with the exception of two samples, but not more so than cast silicon steel of corresponding percentages.

Hardness.—As might be expected from the soft nature of the metal aluminum, its addition to iron does not add materially to the hardness, again in this respect resembling the effect of silicon. Seven to 8 per cent. cast aluminum steel may be readily drilled and filed. Neither does its addition, unlike manganese, interfere with the magnetic susceptibility of the iron present.

Appearance of Fracture.—Aluminum in the cast specimens opens the grain, *i. e.*, increases the size and coarseness of the crystals, and as the higher percentages are reached it is somewhat difficult to distinguish the fractures from those of cast silicon steel. The crystals in the 5 per cent. and upward specimens become very large and cleave somewhat after the nature of spiegeleisen. This accounts for the increasing brittleness of the cast material, and neither the fracture nor the brittleness accompanying it in such samples can be changed by annealing.

FORGED ALUMINUM STEEL.

Malleability.—As high as 5·60 per cent. aluminum may be present before malleability ceases. This is about the same limit as in the silicon steel described by the writer. It may be pointed out, as regards the specimens under discussion, that they are very low in manganese. Notwithstanding this, the malleability is satisfactory.

Mechanical Properties, etc.—Up to 2·24 per cent. aluminum the annealed samples bent double cold, but upon reaching 5 per cent. a great diminution of strength took place, and annealing practically produces no effect.

One difference clearly brought out is that the tensile strength of iron is not increased so much by an addition of aluminum as of silicon. It has been stated that very small percentages of aluminum considerably raise the limit of elasticity. It will be seen from the table of tests, and specially from the two almost carbonless samples just quoted, that this increase is slight, if any, as compared with ordinary steel, and also that aluminum does not raise the elastic limit so much as silicon. Seeing that aluminum is an exceptionally soft and malleable metal, possessing a tensile strength of 8 to 10 tons, it is hardly to be expected that this should have been otherwise, and it is a pity that such incorrect statements as above mentioned are started, without foundation in fact. The elastic limit of samples should always be determined on annealed specimens, as by cold forging or rolling the elastic limit of even mild steel can be readily raised several tons per square inch; and it would hardly be correct to call this the normal permanent set of the sample under examination. Aluminum and silicon, therefore, stiffen iron but little, while carbon, chromium, tungsten, manganese, and nickel clearly increase rigidity; and this, from their nature and hardness, might be expected.

Hardness.—As might be expected from the soft nature of the metal aluminum, its addition to iron does not confer appreciable hardness when in either the forged or cast state. In this respect also it resembles silicon steel. The forged material containing 5 per cent. is very soft and easily drilled or filed. The action of aluminum may therefore be classed along with that of silicon, sulphur, phosphorus, arsenic, and copper, as giving no increase of hardness to iron, in contradistinction to carbon, manganese, chromium, tungsten, and nickel.

Water quenching upon either forged or cast aluminum steel (in which carbon is practically absent) seems to produce no effect, the samples when dipped at even a welding heat being almost unchanged. It has been stated that the influence of aluminum on high carbon or tool steel is to destroy its hardening action. This is quite incorrect; the writer has prepared steel containing 1½ per cent. aluminum and 1 per cent. of carbon, which hardens sufficiently to scratch glass. Here again we have another addition to the lists of elements which, alloyed with iron, do not produce "water-quenched hardness," if the term may be allowed. In fact, notwithstanding that manganese, chromium, tungsten, and nickel do impart a certain and considerable kind of hardness to iron, either in the cast or forged state, carbon retains its position as being the only element which confers upon iron the property of becoming hard by water quenching. In steel made with the hard metals just mentioned, if the carbon present be low, no matter at what heat they are water quenched, the characteristic hardness of carbon steel, such as scratching glass or forming the edge of a cutting tool, is wanting.

Fracture.—Aluminum causes the tough percentages, both in the cast and forged material, to break with dark, fibrous fracture, similar to wrought iron of good quality, only much darker in color. In several of the tested tensile specimens a rough and ribbed surface is noticed, proving looseness of texture.

Weldability.—Samples with 0·61 per cent. of Al, 0·72 per cent. of Al, and 2·20 per cent. of Al were tested for welding, but unsuccessfully. It would be interesting to try electric welding. The writer has always found that these special steels or alloys, such as silicon, manganese, or chromium steel, have slight, if any, welding properties.

Application.—If aluminum can eventually be brought to compete in price with existing alloys, there is a probability of something being done in introducing its use on a larger scale. Aluminum may find a use for certain special purposes, such as in higher carbon steel, where silicon does not seem to act so powerfully in producing soundness as in the case of milder steel with carbon 0·50 per cent. and under. Its special advantage seems to be that it combines in itself the advantages of both silicon and manganese; but so long as alloys containing these metals are so cheap, and aluminum dear, its extensive use seems hardly probable.

Points of Resemblance between Aluminum and Silicon Steel.—Osmond wrote to the author as follows: "In 1888 I made some aluminum steel, and found its tensile strength and elongation were modified almost exactly as by the same proportions of silicon. Second, aluminum, like silicon, causes a precipitation of grapite in cast iron. Third, the cooling curve of the aluminum alloy is nearly the same as that of the 4·50 per cent. silicon alloy. Fourth, aluminum and silicon have almost the same atomic volume."

Effect of Aluminum upon Manganese Steel and Spiegeleisen.—Believing that aluminum, like silicon, would cause a precipitation of graphite, the writer added between 3 and 4 per cent. to ordinary spiegel (12 and 25 per cent. of manganese). The result in both cases was a complete change from the well-known spiegel fracture to that of ordinary close No. 3 gray pig iron. Although there has been this great attraction in the form of the carbon, no change in the non-magnetic properties of the iron was apparent. This experiment, therefore, clearly proves that the neutralization of the special magnetic qualities ordinarily possessed by iron is in manganese compounds quite independent of the particular state or form in which the carbon present exists.

INDIAN PRESERVES.

THE demand for Indian preserves and jams has greatly increased during the past few years. In India preserves and jellies are made of the pear, quince, mango, tamarind, date, banana, guava, and other fruits. In Singapore pineapples are preserved whole, and in the Bahamas the manufacture is also carried on on a large scale, to the extent of nearly 1,000,000 cans annually. Each can of fruit, before the sirup is added, weighs 2 lb. From 12,000 to 14,000 can be filled in a day, and 25,000 pines are usually consumed daily during the season. In Singapore much enterprise has been shown in preserving tropical fruits. There are two or three firms who deal largely in them.

The Indian preserves were formerly much in request. Thus, in the 13th century the most renowned preserve was a paste made of candied ginger. Among other fruits, etc., preserved in their natural state, in sirup, crystallized with sugar, or made into jelly, are the pineapple, bread fruit, ginger, jack fruit, the papaw, mangosteen, pomeloe, guava, and nutmeg. Although in flavor and preparation these preserves may not equal those of Europe, they make an agreeable change.

Pineapples.—The pineapple is one of the best of tropical fruits, although it is produced of a superior quality by European cultivators. Its sweet and acid flavor, and pleasant aroma, make it sought after by consumers of all classes. One house in Singapore ships about 70,000 tins of this fruit. Pineapple marmalade (thought by some to be the most delicious preserve in the world) might also be sold at 5d. per pound in London.

Guava Jelly.—There are two species of guava fruit, the red guava, and the white, or Peruvian guava. Both make excellent sweetmeat paste or jelly, which is very pleasant and nutritious, from its superior power of assimilation with the gastric juice, and perfect development of saccharine.

It is said that a hundred different preserves could be made from a judicious blending of the fruits of the East and West Indies and South America.

The jamun (*Syzygium jambolanum*), a sort of long, dark, purple plum, the size of a large date, makes excellent preserves, and has exactly the flavor of black current jelly, to simulate which large quantities are sent from India to England. It is also used for flavoring other jams.

The fruits of *Inocarpus edulis* are preserved in the Indian Archipelago. A sweet conserve is made in India of the fruits of *Terminalia Chebula*. Another is made of the fruits of *Phyllanthus distichus* at Birdhum in Bengal. The acid calyces of the rosella (*Hibiscus sabdariffa*) are converted into an excellent jelly, which would be highly appreciated in England, if once introduced. Jam and jelly are made in Canada from the fruit of *Shepherdia argentea.*

The fruit of *Spondias*, not unlike a cherry, is made into jelly. The scarlet fruit of the quandong (*Fusanus acuminatus*), the size of a small peach, makes an excellent preserve for tarts in Australia.

The tamarind plum (*Dialium indum*) of Java has a pod filled with a delicate, agreeable pulp, much less acid than the tamarind. The golden drupes of *Spondias cytherea*, or *dulcis*, a native of the Society Islands, are compared, for flavor and fragrance, to the pineapple. The large acid fruits of the kai apple (*Aberia caffra*) of Natal can be converted into a good preserve of the red currant jelly class. The fruit of *Cornea speciosa* is delicious; it is called "mangaba" by the Brazilians, and when ripe is brought in great quantities to Pernambuco for sale.

The fruit of the goumi, of Japan (*Elægnus edulis*), makes excellent preserves, fruit sirups, and tarts. The berries of *Pyrus aucuparia* and of *P. baccata* are made into comfits, conserves, and *compotes.* The fruits of *Astrocarpum ayri*, of Brazil, are made into an excellent preserve, which is much esteemed in that country.

The fruit of the Chinese quince (*Diospyros amara*) is converted into sweetmeats, of which the Chinese are exceedingly fond.

The bread fruit, in sirup or crystallized, may please native palates, but it is not likely to find favor in Europe, being flavorless, and more of a food substance than a fruit.

Preserved ginger is popular in England, but is not much esteemed on the Continent. The Spaniards eat raw ginger in the morning, to give them an appetite; and it is used at table fresh or candied. Among sailors it is considered antiscorbutic. The quantity of preserved ginger imported ranges annually from 1,500 to 2,500 cwt., value £3,500 to £4,300. It forms the bulk of the succades received from the Chinese Empire, 18,000 to 20,000 cwt. coming from Hong Kong. Some ginger is also received from India. The mode of preparing in the East is as follows: The racemes are steeped in vats of water for four days, changing the water once. After being taken out, spread on a table, and well pricked or pierced with bodkins, they are boiled in a copper caldron. They are then steeped for two days and nights in a vat with a mixture of water and rice flour. After this they are washed with a solution of shell lime in a trough, then boiled with an equal weight of sugar, and a little white of egg is added to clarify. The ginger, candied or dried in sugar, is shipped in small squares of zinc. That preserved in sirup is sent out in jars of glazed porcelain of 6 and 8 lb., and packed in cases of six jars. The quality called "mandarin" is put up in barrels.

The *papaw* (*Carica papaya*) is a fleshy, pulpy fruit, of an orange color, sweet and refreshing, which is eaten as the melon is in Europe. This fruit, however, in sirup or crystallized, has very much the taste of a turnip.

The *mangosteen* is a fruit about the size of a mandarin orange, of a sweet flavor, accompanied with a slight acidity, and an odor resembling the raspberry. It is the produce of *Garcinia mangostana*, and is one of the most delicious and famous of the fruits of the Indian Archipelago, ranking with the pineapple. Presents of baskets of it are sent from Singapore to India and China. It is a pleasant fruit, with a delicate but char-

acteristic flavor, partaking of the strawberry, grape, pineapple, and peach. The happy mixture of tart and sweet in the pulp renders it no less salutary than pleasant; and it is the only fruit which sick people are allowed to eat without scruple. In Cochin China they sell at 4s. to 5s. the 100.

The *pomalo* (*Citrus decumana*) is a large fruit of the orange family, with an acid flavor, frequently bitter. The pulp and thick rind, crystallized with sugar, are eatable, but lose much of their natural flavor. It is better known as the shaddock; and the fruit will exceptionally attain a weight of 20 pounds.

The *Mammea Apple* (*Mammea Americana*) is abundant in the West Indies. The pulp is of a sweet, aromatic smell, and of a peculiar, yet delicious flavor. It is sometimes sliced and eaten with sugar or wine, and also makes a very good jam, by being preserved in sugar. Another tropical fruit, the *Mammea sapota*, is known as American marmalade, from the similarity of the flavor of the pulp to the marmalade made from quinces.

The succulent fruits of *Cicca disticha* have an acid sweet flavor, and are eaten cooked, or made into preserve.

The green, fleshy, gratefully acid fruits of *Averrhoa Bilimbe* and *A. Carambola* are preserved, and used for tarts, and for flavoring various dishes.

The *Comquat*, or *Kumquat* (*Citrus japonica*). An excellent preserve is made from the sweet peel and acid pulp of this curious, small, nutmeg-shaped orange in China and Japan.

The red berries of *Carissa carandas* furnish a well known substitute for red current jelly, in India and China.

The Peruvian *cherimoyer* (*Anona cherimolia*) is a highly esteemed succulent fruit, of a most luscious flavor, containing a soft sweet mucilage, resembling strawberries and cream. It is often called the "Queen of Fruits."

The mango, the mangosteen, the custard apple, and the durian, are known by repute only to the people of this country; but while they might easily be frozen and brought here in admirable condition—dishes fit for the gods—no attempt is made to utilize these luscious fruits of India in their fresh state, nor is very much done in preserving them.

The durian (*Durio zibethinus*), although it has a strong offensive smell, is eaten greedily by the Burmese, and as many as 40,000 are annually sent to upper Burma.

The mango (*Mangifera indica*) is the best fruit in India, as highly valued as the peach with us, and forms a considerable portion of the food of large classes of the native inhabitants. The varieties cultivated are about as numerous as are those of the apple. An Indian gentleman has made colored illustrations of more than 200 varieties of this fruit. The quality is difficult to judge of from external appearance. There are large and small, elongated and abbreviated, bright orange colored and green. They vary much in taste, some being of the flavor of honey, some of pineapple, some of orange, while others have distinct flavors of their own. A good mango should be as little stringy as possible, and should not have too much of the turpentine flavor toward where it is attached to the foot stalk; a moderately aromatic savor there is by no means objectionable.

The young unripe fruit are largely consumed in India in tarts, etc., and mango fool there takes the place of gooseberry fool. The half-ripe fruits are also made into a marmalade which resembles much that of apples.

So large is the consumption of this fruit in India that wagon loads, bringing collectively twenty tons of the fruit, have entered the island of Bombay in a single day. The fruit of the finest mangoes have a rich, sweet perfumed flavor, accompanied by a grateful acidity.

The thick juice is by the natives of India squeezed out, spread on plates, and allowed to dry, in order to form the thin cakes known as *amsatta*. The green fruit is sliced and cooked in curry; is made into pickle with salt, mustard, oil, and chillies, and also into preserves and jams by being boiled and cooked in sirup. Some varieties of mango have fruits as big as an infant's head, ovate, with a golden skin, speckled with carmine, and a greengage flavor.

The finest varieties of this almost unequaled fruit seem to thrive in Jamaica (where it was introduced about a century ago) as well as in Bombay. It is the popular fruit there with the negroes.

The Siam mango is a tolerable kind, which sometimes grows to one pound weight. The egg mango is a small, yellow kind, with too much of the turpentine flavor, and too acidulous to be much prized. The horse mango is a very coarse fruit of unpleasant odor, much eaten by the lower classes, and producing cholera, diarrhœa, and dysentery. The Bombay mango, termed "Parsee," is known for its lusciousness and delicacy of flavor, the absence of fiber, firmness of flesh, thinness of skin, and small size of the stone. It must however be admitted that on tasting this delicious fruit for the first time, a slight turpentine flavor is experienced.

A raw guava, or even a raw mango, may not be, to every Englishman's palate, a satisfactory exchange for a mellow pear or a juicy peach, but preserved mango and guava jelly are things by no means to be despised. Some of these preserved foreign fruits are delicacies only to be obtained at some of the best West End houses, at prices too high for ordinary consumers; but if large quantities were sent into the market, and the prices consequently lowered, the demand would become greater, and the sale more profitable, and would probably lead to the introduction of new articles, to the mutual benefit both of ourselves and the growers and preservers of the fruits.

Mango jam is prepared by boiling the mango in sirup, after removing the skins and stones, and the sour juice squeezed out by the free use of forks, and soaking in fresh water. Two pounds of mango to one pound of sugar is the proportion in which it is prepared. Bilimbi jam is made by removing nearly three-fourths of the juice of the fruits *Averthoa bilimbi*, and soaking in water, squeezing the fruit and boiling them in sirup. Nelli jam, from the fruit of *Phyllanthus embelica*, is made in the same manner; proportion of fruit and sugar same as mango.

From Natal there have been shown at the various exhibitions, Amatungula jam, the produce of the fruit of *Arduina grandiflora*, sometimes called the Natal plum. This jam is firm, nearly like that of the quince, and has a rough acid flavor; but is a curious and agreeable preserve.

The gooseberry jelly from there is the produce of *Physalis pubescens*. It is pleasantly sharp, without having the rough, metal-like acid of the amatungula. The guava jelly has the full taste of the West Indian preserve. The pineapple jam has the rich, almost too luscious, taste for which the Natal pines are famed. The loquat is a very sweet and fine preserve, slightly resembling quince marmalade, but with less pronounced individual flavor. The fruit is very delicious in its unpreserved ripe state, having the flavor of an apple grafted upon the flesh of the melting peach, with large apple pips taking the place of the stone, and ripening in massive bunches. Like the peach, the fruit is almost too delicate for a preserve. Its most refined and exquisite qualities do not survive the bath of boiling sugar. The rosella is the preserved fruits or calyces of the *Hibiscus sabdariffa*, which makes an estimable substitute for red currant jelly, particularly relished in hot climates. The grenadilla, the purple fruit of a passion-flower (*Passiflora edulis*), is almost without a rival for a delicate fragrance and perfume, has a sweetish acid taste, and makes an excellent preserve. The St. Helena peach resembles, in the preserved state, a very excellent yellow plum. The shaddock marmalade might also be spoken of as a worthy substitute for the Seville orange marmalade.—*Jour. Society of Arts.*

A NEW METHOD OF EXTRACTING ROOTS.

By E. Westervelt.

There is an easy way of finding the square, cube, and higher roots by equalizing factors.

Every number may be regarded as a power composed of two or more equal factors, either of which is the root. We may begin the process of extraction by separating the number into factors all unequal. But the work will be shortened if we make all but one equal, approximating the root. The remaining one having been found by division, if the sum of all be divided by their number, a nearer approximation will be obtained. The result, however, will always be too large, according to this principle.

The sum of the factors, if unequal, is greater than if equal.

The last figures of the remaining factor therefore may be omitted.

These data are the basis of the following

RULE FOR EXTRACTING ANY ROOT.

1. Separate the number into periods as usual.
2. Choose a convenient trial factor, or proximate root; attach an exponent one less than the index of the root; and divide the number by the power so indicated.
3. Multiply the trial factor by its exponent, add the quotient just obtained, and divide by the index of the root.
4. With this quotient as a second trial factor, repeat the process, and so on till the root is obtained.
5. To shorten the work, start with a proximate root of one or two figures; let the next contain two more; the next four more, and so on; or vary the work to suit the case in hand.

ILLUSTRATIONS.

Extract the square, cube, and seventh roots of 7038149256 to three decimal places.

1. Find $\sqrt{}$ 70, 38, 14, 92, 56.

1st prox. root	9
1st quotient	782
Divide by	2)1682
2d prox. root	841
2d quotient	83687
Divide by	2)167787
3d prox. root	83893
3d quotient	8389435
	2)16778.735
4th prox. root	83893.67
4th quotient	83893686
	)167787.356
The required root	83893.678

2. Find $\sqrt[3]{}$ 7, 038, 149, 256.

1st prox. root	2^2	= 4	1st divisor
× exponent 2 =	4		
Add quotient	175	175	1st quotient
÷ index	3)575		
2d prox. root	$1916.^2$	= 3671+	2d divisor
× 2	3832		
Add quotient	1917.22	1917.22	2d quotient
	3)5749.22		
3d prox. root	1916.406^2	= 3672581+	3d divisor
× 2	3832.812	1916.404	3d quotient
Add quotient	1916 404		
÷ index	3)5749.216		
The required root	1916.405		

3. Find $\sqrt[7]{}$ 703, 8149256.

1st prox. root	25^6	= 24414	1st divisor
Product by exp. 6 =	150		
Add quotient	28.82	28.82	1st quotient
Divide by index	7)178.82		
2d prox. root	25.54^6	= 27753	2d divisor
Product by 6	153.24		
Add quotient	25.359	25.359	2d quotient
Divide by	7)178.599		
3d prox. root	25.514^6	= 25588	3d divisor
Product	153.084		
Add	25.511	25511	3d quotient
	7)178.595		
The required root	25.513		

Fairbury, Illinois, February, 1891.

THE CURIOUS HISTORY OF A LADYBIRD – HOW IT SAVED THE ORANGE INTERESTS OF CALIFORNIA.

Various accounts have been published during the past year of the extraordinary success of the importation of Australian natural enemies of the fluted scale, otherwise known as the "white scale" and as the "cottony cushion scale" (*Icerya purchasi*), into California, and particularly concerning the ladybird (*Vedalia cardinalis*), which has done such excellent and satisfactory work in destroying the injurious scale. No connected account has, however, been published. The results are of such paramount interest as indicating the value of the study of all details connected with the life history of injurious pests that we compile a brief history of the interesting experiment.

Persons who have visited California of late years are familiar with the enormous amount of damage done by the scale insect in question, which, indeed, up to the year 1889, threatened the entire subversion of the orange and lemon interests in California. The insect was considered at length in the annual report of Prof. C. V. Riley, as entomologist to the Department of Agriculture, for 1886. Long accounts of experiments with various washes by agents of the department were given, and importation of parasites was considered. Prof. Riley made use of the following expression:

"Considering the fearful losses already occasioned to California orange growers by two species (the Icerya in question and the California red scale) introduced from Australia, we know of no way in which the department could more advantageously spend a thousand dollars than by sending an expert to Australia to study the parasites of the species there and secure the safe transport of the same to the Pacific Coast."

In the spring of 1887 he urged a similar course, in an address before the State Board of Horticulture, at its meeting at Riverside, having by careful personal study and correspondence ascertained that the insect was without doubt an importation from Australia, and that it had natural enemies there which kept it in check. In the winter of 1887-8 an appeal was made to Congress by those interested for an appropriation to send one or two men to Australia to collect and introduce these natural enemies of the scale. Congress, however, not only failed to make a specific appropriation, but failed likewise to remove the restricting clause in the appropriation to the Department of Agriculture, which limited traveling expenses to the United States.

Imbued with a sense of the importance of the attempt, and unbaffled by the non-action of Congress, Prof. Riley conceived the idea of taking advantage of the Melbourne Exposition. By an arrangement made with the Department of State the Commissioner of Agriculture was finally able to send to Australia two agents of the Entomological Division under instructions from Prof. Riley, their expenses not to exceed $2,000, to be paid out of the Melbourne appropriation.

This co-operation of the two departments was entered into in the belief that it would be mutually beneficial, it being arranged that one of the agents should work under instructions with the commissioner general and assist in reporting on the agricultural aspects of the exposition, while the other was commissioned under instructions of the entomologist and to devote himself solely to the study and importation of the natural enemies of the fluted scale, and report to Prof. Riley. It was the latter's original intention to proceed to Australia himself, but finding that his divisional duties and those which he had assumed in connection with the Paris exposition precluded his so doing, Mr. Albert Koebele was commissioned at his request to proceed to Australia and carry out the entomological work there. The history of Mr. Koebele's efforts has been from time to time detailed in *Insect Life*, a periodical bulletin of the Entomological Division, and particularly in bulletin 21, which contains the official report of Mr. Koebele's trip. A large number of living enemies of the fluted scale, both parasites and predaceous species, were imported into California and turned over to another agent of the division, Mr. D. W. Coquillett, at Los Angeles, Cal. One of them, however, the vedalia, proved so effective as to throw the others entirely in the shade and render their services unnecessary. A recent department publication remarks:

"The little ladybird, which has thus proved itself such a useful aid to California orange growers, has so far received no popular name, but it is already extensively known and spoken of in California as the 'vedalia,' a name which will come to be as common in our language as many other names that were originally purely technical, like phylloxera, geranium, etc. It is a small reddish species, and has four black spots on the back, and confines itself almost exclusively to the fluted scale. It has, so far, not been noticed to prey upon any other insect, a fact which accounts somewhat for its exceptionally rapid work and renders the outlook extremely encouraging.

"It breeds with surprising rapidity and occupies less than thirty days from the laying of the eggs until the adults again appear. At this rate of increase, calculating that 300 eggs are laid by each female and that half of these produce females, it will readily be seen that in six months the offspring of a single female beetle may under favorable circumstances amount to over seventy-five billions."

A report published a year ago from Prof. W. A. Henry, Director of the Wisconsin Experiment Station, who was commissioned by the department to report on the work of its agents on the Pacific Coast, contains the following expression:

"A word in relation to the grand work of the department in the introduction of this one predaceous insect. Without doubt it is the best stroke ever made by the Agricultural Department at Washington. Doubtless other efforts have been productive of greater good, but they were of such character that the people could not clearly see and appreciate the benefits, so that the department did not receive the credit it deserved. Here is the finest illustration possible of the value of the department to give people aid in time of distress. And the distress was very great indeed; of all scale pests, the white scale seems most difficult to cope with, and had no remedy been found, it would probably have destroyed the citrus industry of the State, for its spreading to every grove would probably be only a matter of time. It was the Department of Agriculture at Washington which introduced the

Washington Navel orange into South California, and the department has now given an effective remedy for the worst scale insect. The people will not soon forget these beneficial acts."

WM. F. Channing, of Pasadena, Cal., son of the eminent Unitarian divine, in a recent letter to a friend who has permitted us to publish it gives the following experience:

"We owe to the Agricultural Department the rescue of our orange culture by the importation of the Australian ladybug, *Vedalia cardinalis*.

"The white scale were incrusting our orange trees with a hideous leprosy. They spread with wonderful rapidity, and would have made citrus growth on the whole North American continent impossible within a few years. It took the vedalia, where introduced, only a few weeks absolutely to clean out the white scale. The deliverance was more like a miracle than anything I have ever seen. In the spring of 18~9 I had abandoned my young Washington Navel orange trees as irrecoverable. Those same trees bore from two to three boxes of oranges apiece at the end of the season (or winter and spring of 1890). The consequence of the deliverance is that many hundreds of thousands of orange trees (Navels almost exclusively) have been set out in Southern California this last spring."

In the Agricultural Report for 1889, which has just been published, Prof. Riley thus speaks of the ultimate issue between the ladybird and its prey:

"We may hardly hope, however, that the last chapter in the story is written. On the contrary, it is more than probable, and in fact we strongly anticipate, that the icerya will partially recuperate; that the vedalia will, after its first victorious spread, gradually decrease for lack of food, and that the remnants of the fluted scale will in the interim multiply and spread again. This contest between the plant feeder and its deadliest enemy will go on with alternate fluctuations in the supremacy of either, varying from year to year according to locality or conditions; but there is no reason to doubt that the vedalia will continue substantially victorious, and that the power for serious harm, such as the icerya has done in the past, has been forever destroyed. We have learned, also, that it will always be easy to secure new colonizations of the vedalia where such may prove necessary, or even new importations should these become desirable."

In other words, the victory over this scale is complete and will practically remain so, and we agree with our entomologist when he says in the same report that "the history of the introduction of this pest; its spread for upward of twenty years, and the discouragement which resulted; the numerous experiments which were made to overcome the insect, and its final reduction to unimportant numbers by means of an apparently insignificant little beetle imported for the purpose from Australia, will always remain one of the most interesting stories in the records of practical entomology."

THE GULLFOSS FALLS, ICELAND.

THE boiling mud-caldrons and sulphur springs at Krisuvik, in the south of Iceland, are well worth a visit by tourists who wish to realize what volcanic action actually means. For miles and miles, as far as the eye can reach, nothing but lava mountains and lava bowlders, fissured, torn, and twisted in every imaginable and unimaginable form, can be seen. At short distances puffs of thick white smoke are seen issuing from holes in the ground, and in numerous places the earth is so hot that it burns one's boots. The general impression left on the mind of the visitor is that he is merely standing on a thin crust of earth, beneath which, at a little depth, is a molten furnace.

The Gullfoss Waterfall is situated eight or ten miles northeast of the Great Geyser, and was visited by Dr. Reynolds in July of last year. The river Hvita, here about a quarter of a mile in width, after flowing evenly but swiftly along its course for many miles, through an uninhabited but fairly level country, suddenly begins to descend in a series of beautiful cascades, each from 30 ft. to 40 ft. in height. The water, arriving at the base of each of these cascades in a broken-up condition, again unites, and with a truly magnificent sweep makes a turn of about a quarter of a circle, and then, once more dividing into two nearly equal volumes, plunges headlong into an abyss about 150 ft. deep, some 50 ft. wide at the top, and 10 ft. or 15 ft. wide at the bottom. The chasm, contracting in this extraordinary manner, causes the mighty volume of water to rush away on its course, through a narrow ravine, with a deafening roar. The view is truly splendid, for, as usual in Iceland, the combination of coloring is superb.

The water appears of an old-gold color, hence the name Gull Foss, or Golden Fall; the lava rocks are of a rich purple; the grass is of a vivid green; and a continual rainbow hovers over the side of the main fall, due to the refraction of the solar rays in the enormous body of spray, which, rising to a great height from the falls, descends again in fine rain. This makes a waterproof an absolute necessity to the traveler who is fortunate enough to be able to reach the "Icelandic Niagara," if he does not want to be drenched to the skin.—*Illustrated London News.*

THE GULLFOSS FALLS, ICELAND.

QUARTZ FIBERS.*

By Prof. C. VERNON BOYS.

BEFORE I enter upon the subject upon which I have to address you, I wish to point out that, quite apart from any deficiency on my part, which will be only too apparent in the course of the evening, it is my intention to commit two faults which may well be considered unpardonable. In the first place, I shall speak entirely about my own experiments, even though I know that the iteration of the first personal pronoun for the space of one hour is apt to be as monotonous to an audience as it is wanting in taste on the part of a lecturer. In the second place, I am going almost to depend upon the motions of a spot of light to illustrate the actions which I shall have to describe, in spite of the fact that it is impossible for an audience to get up any enthusiasm when watching the wandering motion of a spot of light, the result of the manipulation of a mystery box, of which it is impossible to see the inside. These, however, are faults which are the immediate consequence of the nature of my subject.

Physicists deal very largely with the measurement of extremely minute forces, which it is of the utmost importance that they should be able to measure accurately. Now forces may be considered under two aspects. It may be that the force which is developed and which has to be measured is a twist, in which case the twisting force may be applied to the end of a wire directly, when the amount through which that wire is twisted is a measure of the twisting force. Or the force may be a direct pull or a push, which may also be measured by the twist of a wire if it is applied to the end of a lever or arm carried by the wire.

Now supposing that the force—whether of the nature of a twist or of a pull, it does not matter which—is too small to produce an appreciable twist in the wire, it is obvious that a finer wire must be employed, but it is not obvious how much more easily a fine wire is twisted than a coarse one. If the fine wire is one-tenth of the diameter of the coarse one, we must multiply ten by itself four times over in order to find how much more easily twisted it is, and thus obtain the enormous number 10,000; it is 10,000 times more easily twisted than the coarse one. Thus there is an enormous advantage in increasing the minuteness of the wire by means of which feeble twisting or pulling forces are measured. But if the delicacy of the research is such that even the finest wire which can be made is still too stiff, then, even though with such wire, which is somewhere about the thousandth of an inch in diameter, forces as small as the millionth part of the weight of a single grain can be detected with certainty, the wire is of no use; and as wire cannot be made finer, some other material must be used. Spun glass is fine and strong, and is still more easily twisted than the finest wire, but it possesses a property somewhat analogous to putty. When it has been twisted and then let go, it does not come back to its old place, so that though it is much more largely twisted than wire by the application of a force, it is not possible with accuracy to measure that force. There is, or rather I should say there was, no material that could be used as a torsion thread finer than spun glass; and therefore physicists use instead a fiber almost free from torsion. A single thread of silk as spun by the silkworm is taken and split down the middle, for it is really double, and one half only is used. This is far finer than spun glass, and being softer in texture, it is much more easily twisted. Silk is ten thousand times more easily twisted than spun glass. So easily twisted is silk that in the majority of instruments the stiffness of the silk is either of no consequence at all, or at any rate it only produces but the slightest disturbing effect. Now if it is necessary to push the investigation further still by the continued increase in the delicacy of the apparatus, silk itself begins to prevent any progress. Silk has a certain stiffness, but if that were always the same it would not matter; but then it possesses that putty-like character of spun glass, but in a far higher degree; it is affected by every variation of temperature and moisture, and any really delicate measures are out of the question when silk is used as the suspending fiber.

This, I believe, is a fairly accurate account of the state of the case three years ago. At that time I was improving, or attempting to improve, a certain class of apparatus of which I shall have more to say presently, and I was met by the difficulty that a greater degree of delicacy was required than was possible with existing torsion threads. Silk would have entirely prevented me from reaching the degree of delicacy

* Lecture delivered by Prof. C. Vernon Boys, F.R.S., on September 8, 1890, at the Leeds meeting of the British Association.

and certainty in this instrument that I hope to show this evening that I have attained.

Being then in this difficulty, I was by good fortune and necessity led to devise a process which I propose at once to show you. I shall not describe the preliminary experiments, but simply describe the process as it stands. There is a small cross bow held in a vise, and a little arrow made of straw with a needle point, and I have here a fragment of rock crystal which has been melted and drawn into a rod. It requires a temperature greater than that developed in any furnace to melt this material so that it may be drawn out. If the arrow, which also carries the piece of the quartz rod, is placed in the bow, and if both pieces are heated up to the melting point and joined together, and then the arrow is shot, a fiber of quartz is drawn—that is to say, it is drawn if there is not an accident.

The arrow has flown, and there is now a fiber, not very fine this time, which I shall hand to our president. At the same time I can pass him a piece of much finer fiber, made this afternoon, which shows (and this is a proof of its fineness) all the brilliant colors of the spider line when the sun shines upon it, but with a degree of magnificence and splendor which has never been seen on any natural object.

The main features of these fibers are these. You can make them as fine as you please; you can make them of very considerable length; you can make pieces 40 or 50 feet long, without the slightest trouble, at almost every shot. Even though of that great length, they are very uniform in diameter from end to end, or, at any rate, the variation is small and perfectly regular. The strength of the fiber is, I think I may safely say, something astonishing. Fibers such as I have in use at the present time in an instrument behind me are stronger than ordinary bar steel; they carry from 80 to 80 tons to the square inch. That is one of their most important features, for this reason—that on account of their enormous strength you can make use of very much finer fibers than would be possible if they were not so strong: and I have already explained the importance of the fineness of the fiber when delicacy is of the first importance.

As to the diameter of these fibers, I have said they can be made as fine as you please. I shall not trouble you with a large number of figures, but one or two may probably be interesting to those who are in the habit of using philosophical apparatus. In the first place, a fiber a great deal finer than a single fiber of silk—that is, one five-thousandth of an inch in diameter—will carry an apparatus more than thirty grains in weight. I have in one of the pieces of apparatus which I shall use presently a fiber the fifteen-thousandth of an inch in diameter. That is, so fine that if you were to take a hundred of them and twist them into a bundle, you would produce a compound cable of the thickness of a single silkworm's thread. I do not mean the silk used for sewing that is wound on a reel, because that is composed of an enormous number of silk threads; but a single silkworm's thread as it is wound from the cocoon, and that fiber is at the present time carrying a mirror, the movements of which will presently be visible in all parts of this large room.

But that is by no means the limit of the degree of fineness which can be reached. A fiber the fifteen-thousandth of an inch in thickness is quite a strong and conspicuous object. You may go on making them until you cannot see them with the naked eye. You may go on following them with the microscope until you cannot see them with the microscope—that is to say, you cannot find their end—they gradually go out. The ends are so fine that it is impossible ever to see them in any microscope that can be constructed, not because the microscopes are bad, but because of the nature of light. But that is a point upon which I shall not say more this evening.

It has been estimated that probably the ends of some of these are as fine as the millionth part of an inch—I do not care whether they are or whether they are not, because they can never be seen and never be used—but certainly the hundred-thousandth of an inch is by no means beyond the limit which can be obtained. As these large numbers of hundreds of thousands and millions are figures which it is impossible for anybody thoroughly to realize, I may, for the purpose of illustration, say that if we were to take a piece of quartz about as big as a walnut, and if we could draw the whole of that into a thread one hundred-thousandth of an inch in diameter—threads which can certainly be produced—there would be enough to go round the world about six or seven times.

These quartz fibers, on account of their fineness, are eminently capable of measuring minute forces—that is to say, they would be capable if they were free from that putty-like quality which I have described as making spun glass useless. Now, experiments made both in this country and Australia show that to a most extraordinary degree they are perfectly free from that one fault of spun glass.

The number of useful properties of quartz that has been melted is so great that I can merely take, in a more or less disjointed way, one or two; and I propose, in the first place, to say something which, I think, may be especially interesting to chemists, and, perhaps, to our president. I should like to ask experimental chemists what they would think of a material which could be drawn into tubes, blown into bulbs, joined together in the same way that glass is joined, drawn out, attached to a Sprengel pump, sealed off with a Sprengel vacuum, which would be transparent, which would be less acted upon than glass by corrosive chemicals, and which, finally, at the point at which platinum is as fluid as water, would still retain its form.

Here is such a tube with a bulb blown at the end. I have found that it is possible to make tubes (though it cannot be done in the ordinary way, as with glass) and to blow bulbs with quartz, and that they have this advantage which glass does not possess—namely, that it is almost impossible to crack them by the sudden application of heat.

Then there is another property which quartz fibers and rods possess which I shall be able to show only imperfectly—namely, the power of insulating anything charged with electricity under conditions under which in general insulation is impossible. You now see upon the screen an electroscope, the leaves of which were charged at noon, and they are still divergent, but not to a very great extent, because they have suffered from unavoidable shaking during the day. The point to which I specially wish to refer is this. In electroscopes and all electrostatic apparatus one puts in a dish of sulphuric acid, which is an abomination, in order to keep the atmosphere dry.

I have in this electroscope such a dish, but it is filled with water in order to keep the atmosphere moist. Experiments carefully made, using the same box—everything the same—except that in one case the insulating stem was made of quartz, and in the second case it was made of the best flint glass, well washed, of the same shape and size, show that, if the atmosphere is perfectly dry, the electricity escapes from both at the same rate; but that, if the atmosphere is perfectly moist, the electricity escapes from the leaves insulated by the clean-washed flint glass only too quickly; whereas, from the leaves insulated by the quartz, the rate is identically the same as it was in either case when the atmosphere was perfectly dry.

I have said that these fibers were uniform in diameter, and fine and smooth and strong, and that they glisten with all the colors of the spider web, but that they are far more brilliant. It was naturally rather a curious point to note what a spider would do if by any chance she should find herself on such a web, and now that I am dealing with live and wild animals which cannot possibly be trained the conditions are such as to render the success of an experiment entirely a matter of chance.

However, I propose to make use of the spider as a test of the very great smoothness and slipperiness of one of these fibers. There are here three little spiders which have been good enough, since they came to Leeds, to spin upon these little wooden frames their perfect and beautiful geometrical webs. I have succeeded in placing one of these frames in the lantern without disturbing the spider, which you can now see waiting upon her web.

I must now, without disturbing the peace of mind of the spider, carry her to a web of quartz; and, therefore, it is necessary that the spider should be fortunate enough to catch a fly. Now, instead of bringing a fly I will make an ordinary tuning fork buzz against the web. She immediately pounces upon the imaginary fly, and thus I can, without frightening her, place her upon the quartz fiber. Unfortunately this spider has slipped and has got away, but with another I am more successful. I intended to show that the small and common garden spider could not climb the quartz fiber, but for some reason this spider is able to get up with difficulty; however, I shall not spend any more time upon this experiment.

I shall now at once speak about the instrument which actually led me to the invention of the process for making quartz fibers. This, which I have called a radio-micrometer, is an instrument of very great delicacy for measuring radiant heat from such a thing as a candle, a fire, the sun, or anything else which radiates heat through space.

The radio-micrometer which I wish to show this evening is resting upon a solid and steady beam, and as usual its index is a spot of light upon the scale. You see that that spot of light is almost perfectly steady. Now the heat that I propose to measure, or rather the influence of which I intend to show you, is the heat which is being radiated from a candle fixed in the front of the upper gallery some 70 or 80 feet from the instrument; and in order that you may be sure that the indication of the instrument is due to the heat from the candle, and not to any manipulation of the apparatus on the beam, I shall perform the experiment as follows:

None of the apparatus at this end of the room will be touched or moved in any way; but by a string I shall simply pull the candle along a slide up to a stop, at which position it will shine upon the sensitive part of the radio-micrometer. Instantly the spot of light darts along the scale for a distance of ten feet, and then after leaving the scale it comes to rest upon the face of the balcony five or six seconds after it began to move.

Now, if the candle is allowed to move back through about a foot, you will see that the instrument will cool down at once—it is at present suffering from the heat which falls upon it from the distant candle; but it will cool down at once, and the index will go back to its old place. It is very nearly at its old place now. I will now let the candle shine upon it again. The index at once goes on to the balcony as before, and now that the candle is moved away again, the index has assumed its old place upon the scale.

That really shows that we have here the means of measuring heat with a degree of delicacy, and also with a degree of certainty, ease and quickness, which has never yet been equaled. It is probable that the measure which I have given of the degree of delicacy that I have reached in my astronomical apparatus—namely, that the heat of a candle more than two miles away can certainly be felt—will not seem so absurd now that you have seen this less perfect apparatus at work, as it does to people whose experience is limited by the thermopile or their senses.

You can now see the spot of light; it is perfectly quiet in its old place. I wish to show you that this instrument is unlike those which are ordinarily used for this purpose. All the heat, the very considerable heat, due to this electric arc lamp, is actually falling on the instrument, but not upon its sensitive surface, and there is no indication. There are a large number of people in the room—it does not feel the heat from them. Stray heat which it is not meant to feel—which is not in the line along which it can see or feel—has no influence upon it. When the candle was moved to the place to which it was looking, it felt the heat, and you saw the movement of the index. What is perhaps more important than all is that it is an instrument which does not even feel the influence of a magnet. I have here a magnet, and on waving the magnet about near the instrument there is no movement of the index at all; it does not dance up and down the scale, as it certainly would do in the case of a galvanometer, because this magnet would affect a galvanometer at the other end of the room. We have then a degree of sensibility which is certainly not easily developed in any other way. I must except, however, the instrument which Professor Langley of America has recently brought to a great state of perfection. I am unable to state, from want of information, whether this instrument is as sensitive as the one I have just shown, but whether it is or is not as sensitive it certainly cannot compare with this in its freedom from the disturbing effects of stray heat falling upon it, or of the magnetic or thermo-electric disturbances which give so much trouble where the galvanometer is employed.

Now this apparatus I was recently using in some astronomical experiments on the heat of the moon and the stars. As these experiments could only be made with an instrument such as this, possessing extreme sensibility and freedom from extraneous disturbances, and as this instrument is both the cause of the discovery and the first result of the application of quartz fibers, I have thought it well to repeat a typical experiment upon the moon's heat, but, like Peter Quince, I am in this difficulty. As he said, "There is two hard things, that is to bring the moonlight into a chamber." In fact, at the present time the moon has not risen, and if it had we should not be much better off. Peter Quince proposed that they should in case of moonlight failing have a lantern and a bunch of thorns. That no doubt was sufficient for the conversation of Pyramus and Thisbe, but that would not do for the purpose of showing the variation of radiation from point to point upon the moon's surface, and as that is the experiment which I now wish to show—an experiment which this instrument enables one to make with the greatest ease and certainty—it is necessary to have something better than a lantern and a bunch of thorns. Therefore I have been obliged, as the moon is not available, to bring a moon. Now this moon is a real moon; it is not a representation; it is not a slide; it is a real moon, and it is made by taking an egg shell and painting it white. That egg shell is now placed upon a stand, and is illuminated by the sun—that is, an electric light—and in order that the moon may be visible the room must be darkened. The moon is now shining in the sky. An image of the moon is cast by means of a concave mirror upon a translucent screen. There is in addition another mirror which throws a small image of the same moon upon the radio-micrometer. There is one more thing to explain. There is upon the screen a black spot which represents the sensitive surface of the radio-micrometer.

That bears the same proportion to the moon which you see on the screen as the sensitive surface of the radio-micrometer bears to the image of the moon that is cast upon it. Now the two mirrors are arranged to move by clockwork, so as to make the two images travel at proportional rates. The moon is traveling with the dark edge foremost, and now that the terminator of the moon has come upon the sensitive surface, the heat is felt and the deflection of the instrument is the result. Now as the moon is gradually traveling through the sky, the radiation is slowly and steadily increasing, because the radiation from the moon gets greater and greater, as the point at which the sun is shining vertically—that is a point at right angles with the terminator—is approached; it is here a maximum, and then it falls back, and as soon as the moon has gone off the instrument, you will see the index fall back almost suddenly. But there is something more. This moon in one respect is better than the other moon. At the present time it represents the moon nineteen days old, a moon, that is to say, which is waning, and which goes through the sky with its dark edge foremost. The clockwork will now bring the moon back again, and convert the nineteen-day moon into a nine-day moon, one in which the bright edge goes forward. What I want you to notice, and it will be perfectly evident, is this, that the spot of light will now go up the scale suddenly, will then rise to a maximum position, and will then fall slowly until the terminator is reached, which proves that in the former case the slow rise and sudden fall, or the present sudden rise and slow fall, was not a peculiarity of the instrument, but was due to the fact that the different points of the moon radiated in the manner which I have stated. There is one point which, as the moon has now left the instrument, I should like to show; that is, that it is a real moon and not a mere slide. That is shown by gradually moving the sun round. Now it is at right angles to the line of view, and we have got the half moon. As it goes round, the moon continues waning, appearing more like a new moon, and at last we have an eclipse of the sun, which may be annular if the proportions of the apparatus are properly arranged.

I wish now to make a few statements as to the delicacy of apparatus that can be made with the help of quartz fibers. I would wish you most distinctly to understand that it is not sufficient to go into a shop and buy apparatus as it is now made, replace the silk by quartz, and to suppose you can get a degree of delicacy such as I have shown you. That is not sufficient. If you take out the silk and put in a quartz fiber the apparatus will be much improved, and you can then increase its delicacy. You will then escape the troubles due to silk. But one after the other a new series of disturbances will appear, and anything like ultimate, extreme and minute accuracy will still seem out of the question.

Now, it has been my business to eliminate one by one these disturbing influences. I will not weary you with a description of them all, and the methods by which they may be certainly provided against. These disturbing causes, which at the present time, with instruments carrying a silk fiber, are not even known to exist, or if known to exist, are practically of no consequence whatever, come one by one into prominence, when you attempt to push the delicacy of your apparatus to the extent that I have reached in the home-made apparatus which I have here this evening. I do not propose to give more than one illustration, and as this is one which I found out by accident, and which at the time very much annoyed me, I imagine that it may be of interest to explain the circumstances under which this was observed.

In the experiments I made on the heat of the moon and the stars it was necessary to determine to what degree of delicacy the apparatus could be brought—that is to say, to determine what deflection would be produced by a known and familiar source of radiation. For this purpose the source of heat that I used was a common candle, placed sufficiently far off to produce a convenient deflection.

I began by placing the candle about 100 yards away, but I was obliged to place the candle at a distance of 250 yards. At that distance I could not conveniently at night turn the shutter on and off with a string. Therefore I adopted the more simple and practical plan of asking my niece to stand at the top of the hill and

to pull the string when I gave the signal. The signal was nothing more nor less than my saying the word "on" or "off," so that without moving I could observe the deflection due to the heat of the candle at that distance.

Those were the circumstances, but when I shouted "on," before the sound could have reached my niece at the top of the hill, the spot of light had been driven violently off the scale. This seemed as if, as I suspected at the time, one of my little eight-legged friends had got inside the apparatus, and feeling the trembling due to the sound, struck forward, as the diadema spider is known to do, and tried to catch the thing that was flying by. But further experiments showed that this was not the case. It happened that the sound of my voice was just that to which the telescope tube would respond. It echoed to that note, the instrument felt the vibration of the air, and that was the result.

In order to show that an instrument will feel the motion in the air under the influence of sound, I have arranged an experiment of the simplest possible character. I should say that the first instrument of this kind was made many years ago by Lord Rayleigh; but I feel sure that even he would not be prepared for the delicacy to which apparatus on this principle can be brought. It simply depends upon this familiar and well known fact.

A card or a leaf allowed to drop through the air does not fall the way of the least resistance—that is, edgeways—but it turns into the position of greatest resistance, and falls broadside on, or it overshoots the mark, and so gets up a spin.

Supposing you take a little mirror suspended at an angle of 45° to the direction of the waves of sound, the instant sound waves proceed to travel, that mirror turns so as to get into such a position as to obstruct them. The mirror that I have for this purpose weighs about the twentieth part of a grain, and the fiber on which it is suspended is about the fifteen-thousandth part of an inch in diameter. The mirror is so small and light that the moment of inertia is a two-hundredth part of that which people ordinarily call the minute and delicate needle of the Thomson mirror galvanometer. With a fiber only a few inches long, there is no difficulty in getting a period of oscillation of ten or eleven seconds.

When the light from the lamp is reflected and falls on the scale, as it will be in a minute, then a movement of the light from one of those great divisions to the next—that is, a movement of three inches—will correspond to a twisting force such as would be produced by pulling the end of a lever an inch long with a force of a thousand-millionth part of the weight of a grain. It would be easy to observe a movement ten or a hundred times less.

My difficulty now is that it is impossible to speak and at the same time to keep that spot at rest, because the instrument is arranged to respond to a certain note. This is not the predominating note of my voice, but since the voice, like all other noises as distinguished from pure musical sounds, consists of a great number of notes, every now and then the note to which the instrument is tuned is sure to be sounded, and then it will respond. Therefore, while I am speaking, it is impossible to keep the spot of light at rest. However, in order to show that the instrument does respond to certain notes, even if feeble, with a degree of energy and suddenness which I believe would never be expected, I shall, with these small organ pipes, sound three notes.

But I must explain beforehand what I am going to do, as the sound of my voice will spoil the experiment. I shall, standing as far away as I can get from the instrument, first sound a note that is too high; I shall then sound a note that is too low; and then I shall sound the note to which the instrument is tuned. I must ask every one during this experiment to be as quiet as possible, as the faintest sound of the right sort will interfere with the success of the experiment. The first two notes sounded loudly produced no result, while the moment the right note was heard the light went violently off the scale and traveled round the room.

When this little organ pipe was blown at the farthest end of the room, this afternoon, it drove the light off the scale, almost as violently as it did just now.

[The Cavendish experiment of observing the attraction due to gravitation between masses of lead was then explained; and the actual experiment, performed with apparatus no larger than a galvanometer, in which the attracting masses were two pounds and fifteen grains respectively, in which the beam was only about five-eighths of an inch long, and in which the total force was less than one ten-millionth of the weight of a grain, was then shown.

The actual deflection on the scale was rather more than ten feet, and eighty seconds were required for the single oscillation. With this apparatus, forces two thousand times as small could be observed, though the fiber is, in comparison with others that were made use of, exceedingly coarse. Forces equivalent to one million-millionth of the weight of a grain were stated to be within the reach of a manageable quartz fiber.]

Now that I have shown all that my limited time has permitted me, I wish finally to answer a question which is frequently put to me, and which possibly some in the room may have asked themselves. The question may be put broadly in this form: "These fibers, no doubt, are very fine, and very wonderful, but are they of any practical use?"

This is a question which I find it difficult to answer, because I do not clearly know what is meant by "practical use." If by "a thing of practical use" you mean something which is good to eat or to drink, or if you mean something which we may employ to protect ourselves from the extremes of heat or cold or moisture, or if you mean—and this is a point which those who have studied biology will perhaps appreciate more than others—something which may be made use of for the purpose of personal adornment; if that is what you mean by "practical use," then, with the exception of the possibility of being able to weave garments of an extraordinary degree of fineness, softness and transparency, quartz fibers are of no "practical use." But if you mean something which will enable a large and distinguished body of men to do that which is most important to them more perfectly than has been possible hitherto—I allude of course to the experimental philosopher and his experimental work, which after all has laid the foundations upon which so much that is called practical actually is built—if this is what you mean, then I hope that the few experiments which I have been able to show this evening are sufficient to prove that quartz fibers are of some practical use; and they have served this additional purpose—with what success I am unable to say—they have provided a subject for an evening lecture of the British Association.

BRAIN WORK AND AGE.

THE recent appearance of an Italian work concerning the "Hygiene of the Head," the publication of statistics in Germany as to the average age in each of the learned professions and in several of the trades, and the general inquiries of the Austrian Society for Popular E lucation as to how prominent Austrians and Germans have grown old, have brought into public discussion abroad the subject of old age and how to attain it. The German statistics have given, perhaps, the most food for new reflection in the statement of the comparative average ages of professors, scientists, and authors on the one side and artisans, lawyers, and doctors on the other. The classification of the data in the biographies of some 7,000 persons resulted in the following allotment of an average term of life to men in the professions:

Speculative sciences..	Mathematics, Philosophy, Theology,	.....71 years.
Beautiful sciences....	Poetry, Drama,	....70·9 years.
Abstruse sciences....	Archæology, Philology,	....70·2 years.
Public affairs	Statesmanship, Generalship, Philanthropy,	...68·18 years.
Natural sciences.....	Chemistry, Physics, Anatomy, Physiology, Medicine,	....68·7 years.
Fine arts....	Sculpture, Architecture, Music,	....67·6 years.

The average age in years and months for men who are not mostly or exclusively brain workers is:

School teachers, gardeners and butchers..	56	10
Tradesmen..................................	56	9
Lawyers and financiers....................	54	3
Doctors.......................................	52	3
Bakers..	51	6
Shoemakers..................................	47	3
Smithies......................................	46	3
Tailors..	45	4
Stonebreakers, printers, etc....	40	–

The statistician also looked up the biographical data in the lives of 1,200 prominent men, and found that 290 of them had lived beyond the age of 80. At the time of death 175 were 80 to 85 years old; 56, 85 to 90; 39, 90 to 95; 10, 95 to 100; 10, 100 to 120.

How have so many men of prominence and onerous duties in public life managed to eke out more than their alloted threescore and ten? The Austrian society has tried to get a general answer to this question by asking old men in the public life of Austria and Germany just what each ascribes his multiplicity of years to. Major-General Baron Von Hauser in Graz, 91 years old, who has fought in four wars and thirty-four battles, walks for three hours every day, rain or shine, and thinks that this habit alone has preserved his health.

The Chief of Division Carl Von Ransonnet, 89 years old, ascribes his continued robustness to the simplicity of his daily life. The Lieutenant Field Marshal Von Macchio, who, although 87 years old, is still a famous mountain climber, has taken a cold bath every morning since his fourteenth year, and believes every one else may lengthen his life by doing the same. Up to ten years ago, he skated whenever there was ice. Count Pfeil-Burghaus, in Silesian Prussia, also 87, attributes the ripeness of his age to cold shower baths.

Anton Ritter Von Schmerling, the head of the Austrian bench, is 85 years old. He wrote to the Society for Popular Education: "I have taken only simple food, have had no mouth for delicacies, and have never smoked. I have, as a rule, drunk only water." Court Councilor Von Turner expressed the opinion that he had lived to be sound at 83 because he had "lived simply and never been drunk."

The speaker of the Austrian House of Representatives, Dr. Franz Smolka, is 89 years old, and sturdy beyond most deputies of 50. When he was a boy his father compelled him to rise early every winter morning and run about barefoot in the snow. This harsh training enabled Smolka to withstand the effects of close confinement in a damp prison cell from 1841 to 1845. Privy Councilor Von Piener, 79 years; General Von Koller, 77 years; and the industrial Baron Von Rosthom, 76 years, ascribed their undiminished vigor to plain living. The Land Marshal Von Felder, of Lower Austria, says he feels fully as strong and exuberant as he felt fifty years ago, because he has, throughout his life, made foot tours through Europe every summer, with his pack on his back and his staff in his hand. One voice from France also answered the society's questions. "I have worked steadily," are Jules Simon's words, "and, thanks to my moderation, have to-day the same habits and energy that I had thirty years ago."

What does the accumulation of years mean for the work of the brain? This is, perhaps, the most interesting question answered by the Italian writer, Paolo Montegazza, in his "Hygiene of the Head." "Whoever is not a good minister of state, a good general, or a good physician at 30 years will never be one," he writes. "Beranger was an author at 16, and Burns at the same age was celebrated in his native village. Calderoni wrote at 14, and Goldoni at 8 put together a comedy that astounded all. Ovid was a child poet. Pope published at 16 his idyls. Schiller at 23 was famous for his 'Robbers.' Goethe was a wonder child. Lord Chatham was at 27 an M. P., and his son was M. P. at 21, and shortly afterward minister. To the same end may be also cited Fox and Canning. The early maturity of great artists and composers is too well known to need comment. In science early maturity is rare, because the collecting of the necessary knowledge is a slow process. The minimum and maximum of early maturity are to be found respectively among composers and scientists, for it is a natural law that the most nearly automatic energy of thought, which is at once the most irresistible and the most independent of training and outside influence, is the most early developed. It must be said, too, that the lateness of maturity among scientists is more apparent than real. A scientist can hardly at 16 publish to the world a great discovery, yet can have gathered the materials for making such a great discovery in the future.

The earliness of the maturity of thought apparently varies in various places and at various periods. In France and England the dramatic talent begins to show itself after the twenty-first year. It grows steadily, reaches its full bloom and energy between twenty-five and thirty, becomes more robust up to fifty or fifty-five, and then begins to wane. Talent for writing tragedies is of earlier development than talent for writing comedies, because it is a product of glowing passion and is developed accordingly in about the twenty-fifth year. Among the great French writers of comedies, on the other hand, we find the most productive age between thirty and forty-five. Very great minds not only ripen very early, but also maintain their bloom longer than do smaller minds. Titian still painted in his ninety-ninth year. Hayez did his best piece when past threescore and ten. Manzoni studied after he had become an old man, and Bufalini spoke most eloquently at ninety. Cicero in old age wrote like a boy, and Humboldt published the fourth volume of his 'Kosmos' in his ninetieth year."

No country in the world furnishes so many illustrations of the remarkable activity of old students as does Germany. The German professor is a man who does not spare himself early or late, who attends all his lectures and classes with clockwork regularity, and yet finds time to write a whole little library on his specialty. Roscher, of Leipsic, the founder of the historical school of political economy, and still writing at 73; Knies in Heidelberg doing his best work in his 70th year, Rau (Germany's Adam Smith) in the harness when he died at 78, Savigny, Ranke, Lorenz von Stein, Windscheid in Leipsic, and scores of other learned professors, who are or have been great, have shown pretty conclusively by their length of life and their unceasing activity in their ripest years that the hardest brain work does not necessarily wear out mind or body.—*New York Sun.*

PEROXIDE OF HYDROGEN.

STOP suppuration! That is the duty that is imposed upon us when we fail to prevent suppuration.

As the ferret hunts the rat, so does peroxide of hydrogen follow pus to its narrowest hiding place, and the pyogenic and other micro organisms are as dead as the rat that the ferret catches, when the peroxide is through with them. Peroxide of hydrogen, H_2O_2, in the strong 15-volume solution is almost as harmless as water, and yet, according to the testimony of Gifford, it kills anthrax spores in a few minutes.

For preventing suppuration, we have bichloride of mercury, hydronaphthol, carbolic acid, and many other antiseptics, but for stopping it abruptly and for sterilizing a suppurating wound, we have only one antiseptic that is generally efficient, so far as I know, and that is the strong peroxide of hydrogen. Therefore I have qualified it, not as "good," not as "useful," but as "necessary."

In abscess of the brain, where we cannot thoroughly wash the pus out of tortuous canals without injuring the tissues, the H_2O_2 injected at a superficial point will follow the pus, and throw it out, too, in a foaming mixture. It is best to inject a small quantity, wait until foaming ceases, and repeat injections until the last one fails to bubble. Then we know that the pus cavity is chemically clean, as far as live microbes are concerned.

In appendicitis we can open the abscess, inject peroxide of hydrogen, and so thoroughly sterilize the pus cavity that we need not fear infection of the general peritoneal cavity if we wish to separate intestinal adhesions and remove the appendix vermiformis. Many a patient, who is now dead, could have been saved if peroxide of hydrogen had been thus used when he had appendicitis.

This single means at our disposal allows us to open the most extensive psoas abscess without dread of septic infection following.

In some cases of purulent conjunctivitis we can build a little wall of wax about the eye, destroy all pus with peroxide of hydrogen, and cut the suppuration short. Give the patient ether if the H_2O_2 causes too much smarting. It is only in the eye, in the nose, and in the urethra that peroxide of hydrogen will need to be preceded by cocaine (or ether) for the purpose of quieting the smarting, for it is elsewhere almost as bland as water.

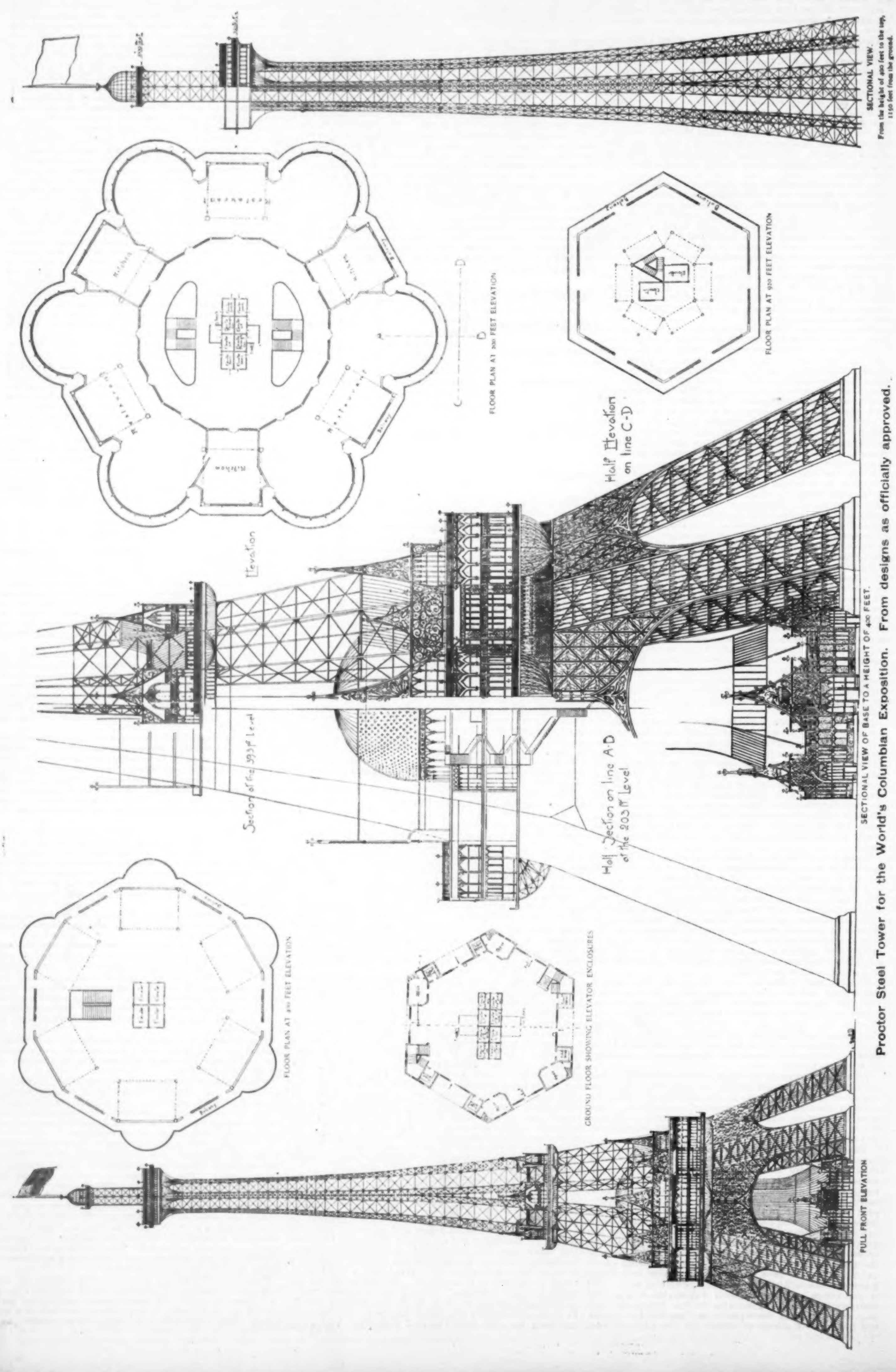
It is possible to open a large abscess of the breast, wash it out with H_2O_2, and have recovery ensue under one antiseptic dressing, without the formation of another drop of pus.

Where cellular tissues are breaking down, and in old sinuses, we are obliged to make repeated applications of the H_2O_2 for many days, and in such cases I usually follow it with balsam of Peru, for balsam of Peru, either in fluid form or used with sterilized oakum, is a most prompt encourager of granulation.

If we apply H_2O_2 on a probang to diphtheritic membranes at intervals of a few moments, they swell up like whipped cream and come away easily, leaving a clean surface. The fluid can be snuffed up into the nose and will render a fetid ozœna odorless.

It is unnecessary for me to speak of further indications for its use, because wherever there is pus we should use peroxide of hydrogen. We are all familiar with the old law: "*Ubi pus, ibi evacua,*" but I would change it to read: "*Ubi pus, ibi evacua, ibi hydrogenum peroxidum infunde.*" That is the rule. The exceptions which prove the rule are easily appreciated when we have them to deal with.

Peroxide of hydrogen is an unstable compound, and becomes weaker as oxygen is given off, but Marchand's 15-volume solution will retain active germicidal powers for many months, if kept tightly corked in a cool place. The price of this manufacturer's preparation is



Proctor Steel Tower for the World's Columbian Exposition. From designs as officially approved.

about 75 cts. per lb., and it can be obtained from any large drug house in this country. When using the H_2O_2 it should not be allowed to come in contact with metals if we wish to preserve its strength, as oxygen is then given off too rapidly.

H_2O_2 must be used with caution about the hair if the color is a matter of importance to the patient, for this drug, under an alias, is the golden hair bleach of the *nymphs du pave*, and a dark haired man with a canary colored mustache is a stirring object.—ROBERT T. MORRIS, M.D., in the *Journ. Amer. Med. Association.*

THE PROCTOR TOWER.

THE Eiffel tower was rightly considered a marvel of engineering skill, but the projected Proctor tower to be erected just outside of Jackson Park, at the head of the Midway Plaisance, excels it 150 feet in height, and is superior in architectural beauty as well as in its special features. The bottom of the tower is composed of six substantial bases each fifty feet square inclosing a surface of some five acres in extent. These bases rest upon a foundation of stone masonry sunk seventeen feet below the surface of the ground and resting upon hard clay.

A central space, some four hundred feet square, will be elegantly floored and walled with marble, and within it will be located the huge engines operating the elevators and dynamos, the ground space at the sides being taken up with booths, refectories and the like. The elevators, which will move in a central shaft, will ascend from the base to a distance of a thousand feet in two minutes' time. These elevators, ten in number, will be constructed and guarded in such a manner that accident will be impossible. Four of the cars will ascend to the second landing, and two will make the journey to the dome, one hundred and fifty feet from the top. At this point an observatory will be located, containing telescopes, and it is not unlikely an exhibit of the signal service of the United States. The landing will inclose an area of 1,225 feet, and will be protected, as will the other two, by a dome. The second landing will cover an area of 6,400 feet, and booths, restaurants and the like will be located here for the refreshment of those who desire to view the city from an altitude of 400 feet. The area of the first landing exceeds the total area of the second and third, and the three together will accommodate 50,000 people at one time, the elevators having a carrying capacity of 8,000 per hour.

The lower portion of this stupendous structure will be of railroad iron and concrete; the superstructure, manufactured at the Carnegie works in Pittsburg, will be entirely of steel, and will be shipped to Chicago in sections ready to be fitted together. Seventy-five hundred tons of steel will enter into the composition, and the plans have been submitted to some of the most eminent engineers of the world, and have received their cordial indorsement. The designer, Mr. David A. Proctor, will manage the enterprise, which, when completed, will stand as a monument unparalleled in the world, and will no doubt be as successful a feature of the Columbian Exposition as the Eiffel tower was of the Paris Exposition. The architect's plans of the tower are presented this week.—*The Graphic, Chicago.*

THE MULTIPLE DISPATCH RAILWAY.*

By MAX E. SCHMIDT.

OF the many problems that have occupied the American mind, none has received more careful thought and closer study than that of providing means for the transportation of large crowds of people. The novel railway represented in this model deals with this problem, and by providing for the conveyance of passengers to their seats, while the railway is in motion, obtains a carrying and seating capacity which will exceed that of any other device heretofore applied for the safe and comfortable transportation of passengers in populous cities.

The railway referred to is the joint invention of Mr. J. L. Silsbee, architect, of this city, and myself, and is secured by United States letters patent, with applications for European patents pending.

In the description which follows, the middle platform of the three will be referred to as the car, and the others as the outside platforms.

As will be seen from the engravings, the invention consists essentially of three continuous platforms, of which the middle one, or car, contains seats and travels just twice as fast as the outer ones. This is accomplished by attaching the cars to movable flexible tracks resting upon the peripheries of wheels mounted upon such axles, so that as the wheels and axles run upon fixed tracks at a certain ratio of speed of the axles, the movable rails and cars attached thereto will move at double the ratio of speed of the axles, since the movable rails are carried along with the axles and also have a motion relatively to such axles, owing to the friction between the wheels and the movable rails. In the combination of platforms above referred to, the two outer ones are mounted on the axles and the middle ones on the peripheries of the wheels, with the result that the differential rate of speed between the three platforms is constantly maintained, no matter at what rate it is found desirable to run the train for the safe admission of passengers.

It is intended that these platforms and cars shall travel continuously on an endless railway and that passengers shall step upon the platforms, traveling at the lower speed, and thence to the cars provided with seats, traveling at double the speed, while the railway is in motion.

In this connection, it is supposed that a person can step on a platform that is approximately level with the ground and moves at about the rate of a walk, or say four miles per hour. In this city, the drawbridges, when swinging on the abutments, move at the rate of $3\frac{1}{2}$ to $3\frac{3}{4}$ miles per hour, and the people do not hesitate to step on or off while the bridge is in motion. While four miles per hour is therefore generally accepted as the average gait of a walk, it has been assumed in this instance that in practice, and to insure additional safety, the speed to be given to the outside platforms, or the axle speed, should not exceed three miles per hour, and that each succeeding platform should increase at that rate.

The diagram on sheet No. 3 of the patent specifications explains the further application of the principle to platforms that are to travel at more than twice the axle speed, and in which case, as in the combination of three platforms, the speed of each succeeding platform is always maintained at an exact multiple of the axle speed. The certainty with which these differential or multiple speeds are maintained, for each belt of moving platforms, though motive power at a low rate of speed is applied to the axle only, is the advantage of this system, because by increasing or decreasing the axle speed all platform speeds are simultaneously and automatically increased or decreased, and the practical operation of the system is thereby made extremely simple and safe.

In the construction of the train of the three platform combination, the two outside platforms, traveling at the lower speed, are supported upon a wooden framework, consisting of four longitudinal floor sills, secured at their ends by transverse end sills. They are built in sections 9 ft., more or less, in length, and each section is supported on a pair of wheels and one axle placed near one end. The other end of the section rests upon the rear of the preceding one, and is coupled to the same. The weight of that end of the section, however, does not come upon the drawhead, but is taken up by two castings, one on each side, and these rest upon bearing plates on the end sill of the preceding car. The cars are therefore designed somewhat following the principle of two-wheel carts, having practically no rigid wheel base, and are constructed to go round curves of small radius.

The wheels are pressed upon the axles to any required gauge, but the axles are considerably longer than the usual practice and have outside bearings for the support of the outer platforms.

The middle platform or car, which travels upon the top of the wheels, is built in sections of the same lengths as the outside platforms. A track of the same gauge as the fixed track, but consisting of two continuous flexible rails, is attached to the bottom of the middle platforms and holds them in position while traveling on the peripheries of the wheels. These rails are made flexible to assist in going round curves of varying radii, and this is accomplished by making them of three strips of steel (see detail drawings) set on edge and joined in such manner that each wheel has, at all times, a bearing on at least two of these strips which form the rail. They are joined by expansion bolts, like the rails in the fixed track, and their ends are left a sufficient distance apart to provide for the necessary amount of longitudinal motion, expansion, and contraction required when passing a curve. The rails are rigidly fastened at equal intervals to the cars by means of chairs, thus confining the longitudinal motion to short chords, and the rails, being thin and flexible and having no intermediate fastening, through the pressure of the flanges of the wheels against them, conform to any curve which they may be called upon to pass. To run such a railway without flexible rails on an endless track is impossible. The rails might be curved to one curve only, in which event they would run on that curve but not on tangents or other curves, or they might be left rigid and straight, in which event they would be useful on tangents but not on an endless track, which must necessarily have at least 360 deg. of curvature.

A rubber or steel spring is interposed at each chair between the flexible track and the platform to insure smooth riding, but as the speed is low, not much rolling movement or noise need be expected, the motion of the cars being more like that of a sleigh.

The middle platform, or car, may be made as wide as desired, and with as many transverse or longitudinal seats as desired; it may be an open or a closed car, but should have a passageway on each side for the use of the passengers. Steadying posts, or railings, are placed within arm length of the edge of the platforms, to be used by passengers in getting on or off. Sliding plates are provided at the junction of the various sections, both of the cars and side platforms, which are bolted to one platform and lap over the other, so that they may slide freely in passing the curves. The steps from platform to platform are not over 2 in. high, and have fastened to them a narrow apron of coarse rubber or leather, which effectively prevents any one from being caught under the edge of the platform, or becoming in any way injured.

That it is safe and practicable for passengers to get on and off a platform, moving three miles per hour, can be proved by fitting an ordinary flat railway car with overlap and post, or railing as proposed, and giving the matter an actual test in practice from a stationary platform. Railway men, as a rule, do not doubt that even old people can step on such platforms, provided they move slow enough and are not much above the level of the ground. There are, moreover, many ways by which this step can be made much safer than the boarding of a train, or a street car, in the crowded streets of a city. There will, of course, be attendants, and rubber mats may be placed along the edges of platforms to secure better footing. As there will be no vehicles to look out for, passengers can use their time and deliberation when stepping off and on, and the chances of getting injured from a fall on a board are trifling as compared with those incident to a fall on a street, where a person is in danger of being run over.

People without the use of their limbs are not supposed to travel on public conveyances without attendants, and there should be no difficulty in rolling invalid chairs on the platforms while in motion. In this connection it is well known that railway speeds are often overestimated and that few people outside of railway men have a correct conception of the low speed represented by three miles per hour.

Derailments and the heating of journals or bearings, as well as breakages of couplings, bolts or other parts of the rolling stock, occur much more frequently on trains running at high speed than at low speed, and when they do occur at low speed they are not followed by serious accidents. Breakages of locomotives in this case are avoided altogether, as the source of motive power will be stationary, and there can, therefore, be no question as to the safety of passengers while in transit.

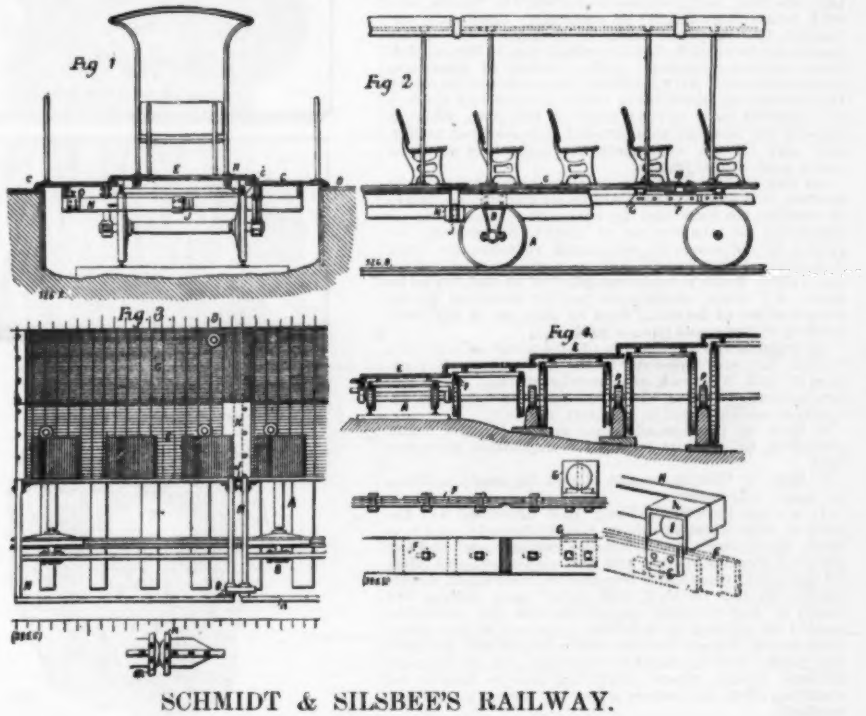
The motive power will be transmitted by cable or electricity, with present conditions favoring electricity. If electricity is used, it will be supplied through circuits from dynamos to motors attached to the axle of the platforms, the number of motors depending upon the amount of horse power that each motor will develop. They will all be started and stopped simultaneously once a day from a central or intermediate station or stations, as may be desired.

As regards the power required to transport one passenger, the manifest object of the road is to combine immense carrying capacity with low speeds. Hence, when there are no crowds to transport there will be no necessity for a road of this class, as the power required to transport one passenger would in that case probably be greater than on an ordinary railway. But, when the crowds are there and the railway attains its object, then the motive power required to transport one passenger will be much smaller, and probably not exceed one-fourth of that required on an ordinary railway.

A considerable saving in operating expenses will result from the fact that no motive power is wasted by constant stops and starts, and that owing to the low speed the wear on the track and rolling stock will be slight.

The system becomes, therefore, applicable wherever large crowds require transportation, as on main thoroughfares, like Broadway, New York; the Strand, London; or Rue Rivoli, Paris; or at bridges and tunnels adjoining large cities, or on exposition grounds, or for suburban traffic in general.

To make this point clearer, the following table gives the number of passengers that can be carried seated per hour on a railway built on this plan, at the differential rate of three miles per hour, and with two,



SCHMIDT & SILSBEE'S RAILWAY.

* A paper read before the Western Society of Engineers, Chicago.—*Engineering.*

three, and four seats abreast respectively, placed every three feet:

Number of Platforms.	Number of Seated Passengers Carried per Hour.		
	Two Seats Abreast.	Three Seats Abreast.	Four Seats Abreast.
First platform moving three miles per hour, then second platform moving six miles per hour, will carry ...	21,120	31,680	42,240
Third platform, moving nine miles per hour, will carry ...	31,680	47,520	63,360
Fourth platform, moving twelve miles per hour, will carry ...	42,240	63,360	84,480
Fifth platform, moving fifteen miles per hour, will carry ...	52,800	79,200	105,600
Sixth platform, moving eighteen miles per hour, will carry ...	63,360	95,040	126,720

It will be seen with reference to this table that even the lowest figure, 21,120 passengers, carried by the second two-seated platform at six miles per hour, is far in excess of the capacity of any other known mode of transportation. At the Brooklyn Bridge the maximum carrying capacity by the trains of the compound cable and steam railway is about 14,000 passengers per hour, and that is only made possible by appropriating every square inch of floor space for standing room. The ever increasing traffic on this bridge, and the problem of how to provide adequate means for the same, has recently led to the appointment of experts, who are considering means of relief for the terminals of the bridge. It is believed that this railway, with proper modifications to conform with the local conditions, will meet the requirements of this bridge to an exceptional degree.

To resume, the main advantages of a railway on this plan are that, being endless and always in motion, and with a carrying capacity of passengers practically unlimited, the proposed mode of transportation comes nearer conforming to the American idea of locomotion than anything known in the history of passenger transportation. All the delays that combine to worry the traveler on an ordinary street or suburban railway are removed on a railway built on this plan, which is equally well adapted to depressed as to elevated tracks, and may have a superstructure consisting of light bents and simple trusses.

On this railway, with its train of cars constantly in motion, it is evident there will be no waiting, no delays at stations, no time lost in consulting time cards, no switching or obstructing of tracks, no crowds, no smoke, no collisions, no misplaced switches, no train orders to misunderstand, but seats will be provided for everybody, while nobody can get left, or lost, try as he may. All these advantages can be obtained by the simple effort of learning how to step on a platform moving at less speed than a walk.

As regards the application of this novel railway to a world's fair, and especially to the Columbian Exposition of 1893, it should be remembered that there are two serious problems which have confronted every exposition management in the past, namely:

1. How to provide adequate means for the transportation of visitors within the exposition grounds; and

2. How to furnish means of rest for many millions of weary sightseers.

It is clear that the railway just described will dispose of both these problems simultaneously, and in a most satisfactory manner to the management and the public. Transportation and rest, on the scale as offered here, and practically free and without limit, as furnished by this railway, has never been within the reach of any previous exposition, and the invention should be utilized in its fullest scope and widest sense. Heretofore, transportation within exposition grounds has chiefly been confined to crowded cars on ordinary railway trains, where perspiring people fought for standing room, and where a journey meant untold discomforts.

Likewise, the provisions for rest have been so insufficient that the fatigue incident to finding a special object was often so great that all interest in the same would disappear before the object was found. As a rule, seats on exposition grounds have commanded exorbitant prices, and at the restaurants it has generally been understood that their use was limited to the length of the repast. This railway removes these defects and materially assists the exposition in one of its greatest missions, viz., to facilitate the study and the comparison between the various parts and classes of the exhibit.

To fulfill its object in the widest sense at the exposition, the railway should be free to all visitors and admit passengers without fare or additional compensation. No embargo should be placed on this condition, and every visitor, upon entering the exposition, should be made to understand that, in purchasing his ticket, and coupon attached, he has paid for the privilege of riding on the railway whenever, and for whatever distance, he chooses.

The addition to the price of general admission that would be required would be trifling when compared with the comforts of the visitors, and much less than if the fare were collected for every ride. By an arrangement like this, the platforms composing the railway could be placed on a level with the grounds, the railway would not have to be fenced in, or be encumbered by ticket offices and gates, but could be thrown open to all, enabling everybody to get on or off whenever and wherever he pleases, without waiting or crowding. It is believed that such a railway will be a wonder in itself, not only as illustrating the American idea of locomotion, but because of its extreme simplicity of construction; and, after once tried, there can be no doubt as to its frequent repetition and future application until something is invented that is superior and better.

In conclusion it should be stated that the plans have been examined by mechanical experts and railway men in the West, who have pronounced them entirely feasible. The theoretical and mechanical principles involved have been found correct, the arrangement for obtaining the increased speed of the central platform has been pronounced ingenious, and the simplest and most direct method by which such change of speed can be accomplished, and the hope has been expressed that a road on this plan would soon be built and the important principles involved therein tested in practice.

SEPARABLE MOSAIC PANELS.

MOSAIC panels are manufactured by one or the other of the following processes.

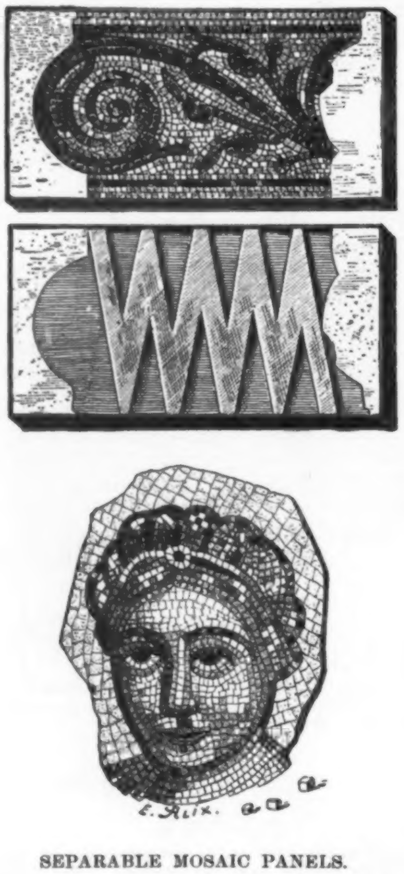
The small cubes of enamel designed for forming the mosaic are placed alongside of each other and embedded in a special cement. The artist can thus constantly compare and follow all the shades of his design.

Another and more rapid process consists in making a sketch of the subject upon strong paper containing but little sizing. The artist then takes the cubes and glues them, face down, to the paper. After this, he takes the whole and applies it to the cement of the wall to be decorated. The paper is removed by moistening it, and it then only remains to perfect the joints.

As may be seen from this, the manufacture of mosaics requires skillful operators that are not to be found everywhere. Moreover, the manufactured panels cannot be carried about without difficulty. The inventor of separable panels has proposed to overcome these difficulties, and to this effect has devised the following process.

He forms directly upon a bed of cement the parts of the design to be executed, and cuts them apart in such a way as to permit of their being easily joined together.

Each of these parts is enveloped with plaster and a rectangular frame of thin hoop wood. In order to put these parts of the design in place, it is only necessary to strip off the frame and remove the plaster. All



SEPARABLE MOSAIC PANELS.

the pieces fit together like squares of faience, and may be put in place by means of cement.—*Les Inventions Nouvelles.*

PHOTOGRAPHS IN PRINTING INK.

IN a lecture by Mr. Warnerke he began by describing the Woodburytype, Edwards' heliotype, the zinc photo-mechanical process of Captain Waterhouse, and the Southampton process; also Albertype, lichtdruck, collotype, and collographic processes, all of which, and many others, including those under discussion, depend upon the well-known property that gelatine possesses when impregnated with bichromate of potash, that is, of being sensitive to light. This is the pith and essence of the whole of these processes, that when a bichromated film is exposed under a negative, those parts that are unprotected from the light have the power of receiving or absorbing a greasy ink, and those parts that are protected repel the ink, the bichromated gelatine acting, in fact, like a lithographic stone, only more faithfully, because you can obtain a rich, pure black by the process described by Mr. Warnerke, and you cannot do so by lithography. And this bichromated film also possesses another very interesting feature, that exactly as the action of the light has acted, so is the *tint* or *half tone*. In fact, these films are in strong relief, like sometimes is seen on a developed dry plate still moist, or on a varnished negative.

When it is mentioned that the lecturette and the demonstration, which included starting with a clean film to the actual production of half a dozen prints, did not occupy one and a half hours, and after the first dozen are got off the printing proceeds at the rate of two to three a minute, and remembering that these are finished prints all ready for mounting, there is one other, or perhaps it would be better to say another, advantage, and it is this: Any paper that is sized can be used, from common fish paper, 4d. per quire, to the most highly glazed chromo-lithographic paper, white or colored. It is also possible, in fact, easy, to print titles or a tint and the picture all at one operation.

The complete apparatus is supplied by representatives of the company in London.

In the demonstration that followed the introduction, Mr. Warnerke explained that he saw the patentee working the process at a Continental international exhibition, and that until recently he has been obliged to obtain the materials from Paris.

The first thing shown was a roll of vegetable parchment coated with plain gelatine; this is cut to size, some two inches or so larger than the picture is to be when finished, and immersed or floated upon a three per cent. solution of bichromate of potash for about three minutes, temperature 50° to 60° Fahr.; if colder, float rather longer; if warmer, reduce temperature with ice, or float a trifle shorter; immerse if many sheets are to be done.

Increased floating makes the film more sensitive, a disadvantage with thin negatives, but a positive advantage with dense negatives. The film is slowly withdrawn over the edge of the bath, suspended for a few minutes to allow surplus moisture to drip, and squeegeed on to a piece of clean plate glass, previously dusted with talc or French chalk, talc sprinkled on the glass and nearly all of it rubbed off, just leaving an invisible film.

If coated overnight and stood up to dry, the film should be ready the next morning. Note, bichromate of potash and gelatine are not sensitive to light when wet, but the dried film possesses about the same rapidity as ordinary sensitive albumenized silver paper. There is this exception, that it possesses to a remarkable degree what is known as the continuing action of light, so a little more care is needed until the film is stripped from the glass, which is the next operation, and the film carefully stored away from the light. These films are in their best condition up to the third or fourth day, and are quite useless after three weeks. The exposure is made thus: An ordinary photographic printing frame with glass in front is used, sufficiently large to take the film; thus, for a half plate negative a 10 × 8 frame, and for a whole plate at least a 12 × 10 frame; the negative and film are laid down in the usual manner, and a nice piece of white blotting paper is next laid on, after which the usual padding, and the back placed in position, and printed, if possible, in sun or strong light; in many cases it is advisable to cover over the frame with a sheet of tissue paper. The image can be seen as the printing goes on, but if the film is looked at, it should be in the dark room or a very subdued light.

When it is well printed out, remove from frame, and place film face downward on a piece of black velvet, a drawing board covered with black velvet is the best to use in regular practice; cover with a piece of glass and expose the back of the film to a moderate light for about five minutes, *just to tint the back*. This renders it insoluble, and saves the transferring it to zinc or stone. This is the pith of the process. It is now placed in a dish to dissolve out the unaltered bichromate of potash by soaking it in water and giving frequent changes, or by running water; leave in till the film is quite clear, faintly opalescent (about four hours is the average time), take out and just drain, squeegee carefully on to glass, film upward, pour on the glycerine solution described at foot, drain off, something like coating a plate with emulsion, *i. e.*, leave enough on and set to dry in a level place free from dust. A box lid is not a bad thing to put over, or make a square of four pieces of wood, stretch a few strings across, and throw over the top a sheet or so of paper. The solution remaining on one hour, this hardens and toughens the film, and the same solution is dabbed on whenever the film seems to soften during the action of printing.

In cold weather some 300 could be easily obtained without rehardening, but in summer, perhaps, not more than fifty or sixty. Next, the film is placed in a special frame something like artists use when a water-color drawing is in process of being painted. It may be briefly described as a stretcher frame fitting over another frame, and at the back a padded block of wood fits in, so that the film rests upon this padded block.

Thick and thin lithographers' ink, special varnish, and a piece of lard; two special rollers, one for each ink, a palette knife, and two glass slabs to mull and roll the ink on are required, also an ordinary copying press, such as is found in all commercial offices; these, with sized paper, complete the outfit. A very little of each ink is placed on each glass slab and carefully worked up and down and across the slab, then the roller with the thick ink is carefully and slowly rolled on the film, beginning at the right hand end, so that the foreground and middle distance is inked. The change in the film is magical, a picture seems to start from under the roller. This inking is repeated a few times, then the thin ink roller is passed slowly over the whole, thus working in the shadows and the half tints, the lights being formed of the paper itself. After several proofs have been pulled (usually ten to twelve) the printer finds out how much of each ink to use for each impression, and then the work proceeds rapidly.

Instructions for working off the impression. First thing, to cut a thin paper mask the size the picture is to show; in fact, cut two or three while about it, in case of damaging the one in use. This is fastened on one side or end with gummed paper forming a hinge, because it has to be lifted off each time the skin or film is inked.

The film having the needful number of proofs pulled off, has the mask fastened down as before described, a pad or two of felt is placed under the block that supports the film, unless this has been done previously. The thick ink is rolled on and then the thin all over, and it is instructive to notice the difference that slow, quick, or medium rolling gives; then the paper mask is hinged over. Next, lay in the paper that the impression is to be printed upon, then the needful number of blankets, as they are called in the letterpress printing trade, better known to us as felt pads. The whole affair is now placed in the copying press, the screw turned for pressure, returned, the frame withdrawn, the blankets removed, and paper carefully taken off by one edge or side, and then you see the print in all its beauty, and it is thoroughly permanent. As before stated, any color or tint that you prefer may be used to ink it; and so on repeating the process. Gilt,

designs, lines, and titles can easily be made by using a gilder's mop and brushing in with it some gold or gold bronze powder, or any colored bronze powder can be used, and then brushing it off, as it only adheres to the inked portion.

The glycerine solution is made as follows:

Glycerine	70	parts.
Water	13	"
Liquid ammonia	3	"

An apparatus to print a quarter plate surface, that is, a picture $4\frac{1}{4} \times 3\frac{1}{4}$, with a white margin proportionate to the size of the picture, only costs £2 15s., and for a picture 12×10 only £4, less than double the price of the quarter size, and a much more useful size. The films also make excellent MS. copying machines, and are superior to the usual gelatine graph.—*Archer Clarke, in Br. Jour. of Photo.*

INSTRUMENTS FOR DRAWING CURVES.

By Prof. C. W. MacCord, Sc.D.

X.—THE POLAR HARMONIC.

In Fig. 1 let C M, C N, be two radii of the generating circle, including any arbitrary angle; through M draw a horizontal line, and produce C N to cut it in P. Let the two radii rotate about C with the same angular velocity, thus including a constant angle, the line through M remaining horizontal, and cutting the radius through N or its prolongation. The points thus determined lie upon a curve C O P, which may be properly called the Polar Harmonic, since these points are the intersections of a radius vector rotating uniformly about the pole C, with a horizontal line moving across the generating circle with a perfect harmonic motion.

Draw the horizontal diameter A C E, and set off E K equal to N M; then C E must be produced to infinity before meeting the horizontal through K, which, therefore, is an asymptote to the curve.

Draw a horizontal through the extremity of the vertical radius C D; this will be tangent to the curve at a point Q on the prolongation of C I, the arc D I being equal to M N. Continuing the rotation to the left, the curve cuts the circumference of the generating circle and approaches the pole, which it will reach when C M coincides with C A; at that instant, N will fall at H, and H C will be tangent to the curve.

Still continuing the rotation, the curve passes below A E in the direction C V, until, when N reaches A, the radius C M falls at C R, and a horizontal through R is an asymptote to C V, which extends to infinity on the right. Thus we see that the branch X P O C V is generated by the rotation of C N from the position C E to the position C A, in the direction indicated by the arrow. During the completion of the rotation in the same direction, it will be apparent that a similar branch U T C W will be formed, extending to infinity on the left, and having a horizontal tangent through the lower extremity, J, of the vertical diameter of the generating circle.

A very simple device for drawing a portion of one branch of this curve is shown in Fig. 2. A lever, L L, has a hub on its upper side, in which is fixed the shaft C. In the lower face of this lever is a groove, in which a block slides freely. This block is pivoted to another one, which slides in a slot formed in the horizontal connecting rod A B; this rod is pivoted at M to a projection on the side of L L, and at its ends to two cranks A E, B F, each equal and parallel to M C. The bearings for E, C, and F are formed in a bar T T, supported at a convenient height above the frame G G by standards H H H. The extension of the pivot P is centrally drilled to form a holder for the pencil, which, as a comparison with Fig. 1 at once shows, will trace the right-hand branch of the Polar Harmonic, C M being the radius of the generating circle.

Since the arcs H A, A R, D I, in Fig. 1, are each equal to M N, it will be seen that as the arbitrary angle M C N increases, the greater will be the vertical distance between the asymptotes, and the farther will the point of tangency Q recede to the right; until, when M C N becomes a right angle, the point Q is infinitely remote, and the asymptotes pass through the extremities of the vertical diameter of the generating circle. In this case the two branches are symmetrical with respect to the horizontal axis through C, and, as shown in Fig. 3, are strikingly similar in appearance to the subquadratrix having the same generating circle: the resemblance being closest near the vertex, because the motion of the horizontal line is more nearly uniform, the nearer it is to the axis of the curve.

It may be of interest to note that if in Fig. 1 we suppose C M to start from the position C A, and the rotation to be to the right, the portion C O P X will be first generated, then the portion W C; but in either case, when the curve disappears at infinity on one side, it at once reappears at infinity on the other side, while the rotation continues in the same direction. This, of course, is a sufficiently common phenomenon in connection with curves having infinite and opposite branches. But, as will be shown in a subsequent article, the device here illustrated may be so modified as to produce a curve closely resembling a portion of the Polar Harmonic, which, disappearing at infinity on either hand, reappears, not at an infinite distance, but at the pole, by a continuation of the same law of generation.

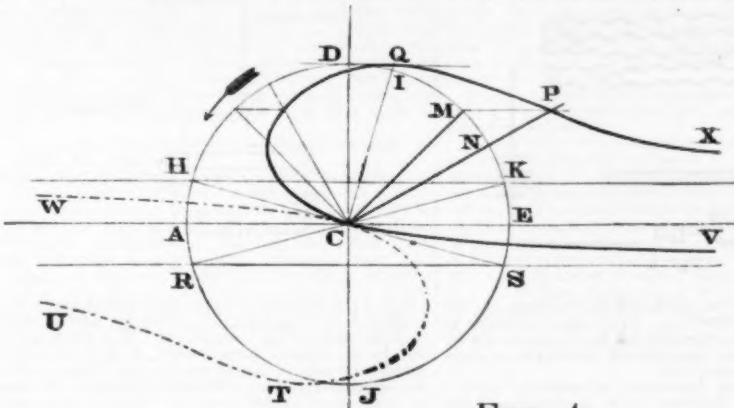


FIG. 1.

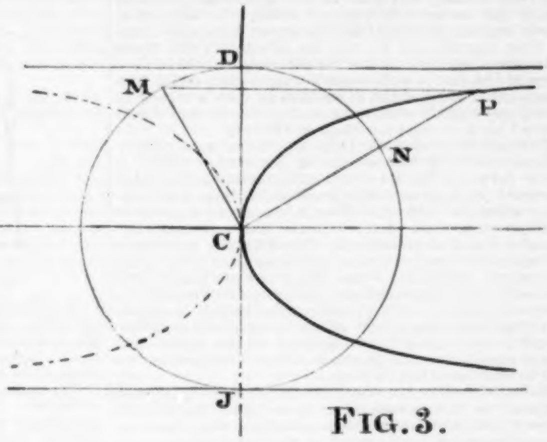
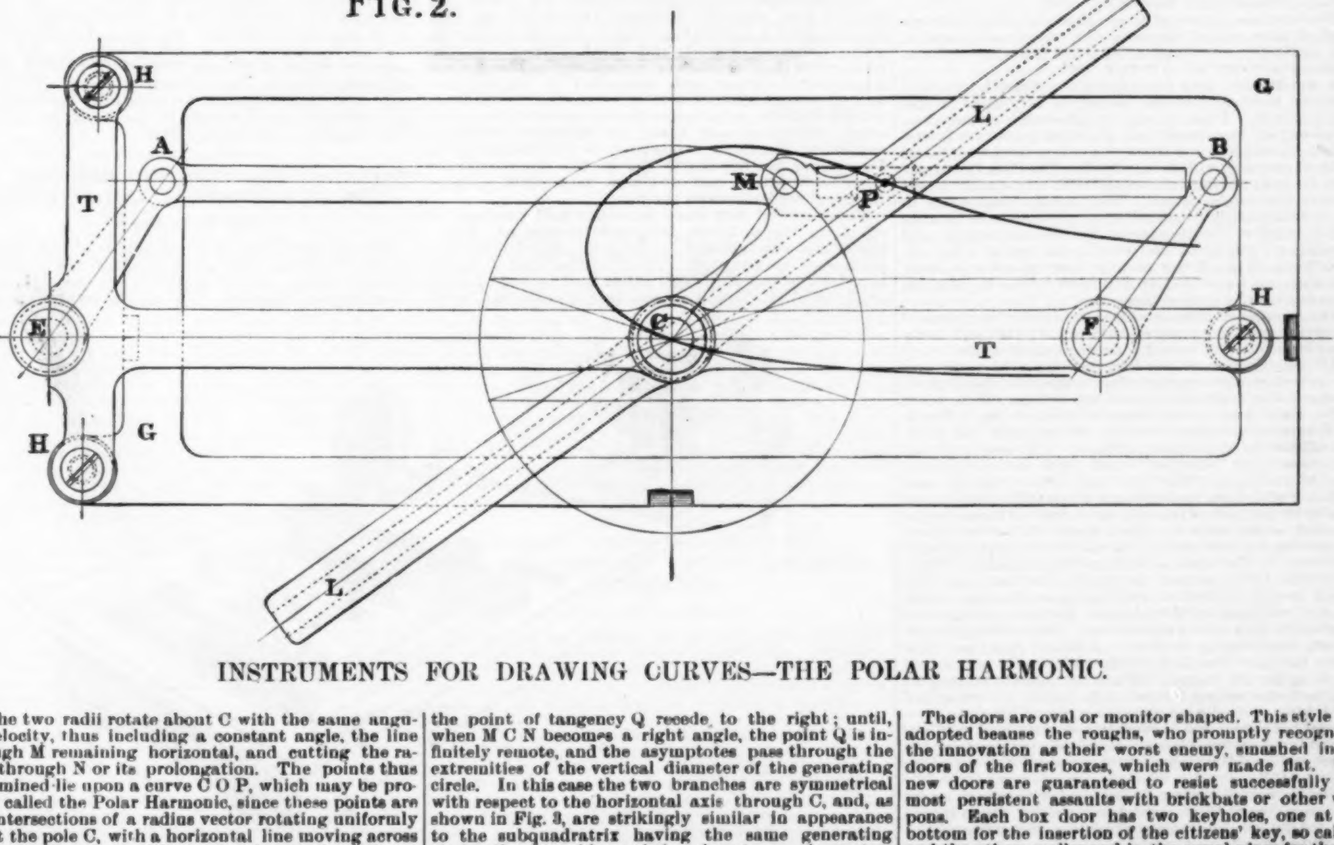


FIG. 3.

FIG. 2.



INSTRUMENTS FOR DRAWING CURVES—THE POLAR HARMONIC.

ELECTRICAL POLICE APPARATUS.

No city in the country is better equipped than Boston with electrical apparatus for promoting the efficiency of its police department. It has used the system of street signaling for five years, and its value in the estimation of the police has constantly increased. Improvements have from time to time been made until now the work done approaches as near perfection as seems possible. The system is that manufactured by the Municipal Signal Company, but a description of it will, in many respects, apply as well to the Gamewell apparatus, so much do the two systems resemble each other.

The features of the system visible to the ordinary citizen are the alarm box, similar to a fire alarm box, and placed at frequent intervals on street corners, and the patrol wagon, carrying two or three patrolmen, a stretcher, etc., which responds to the signals. Such boxes might best be placed upon lamp posts. In such cases they would be indicated by a green pane of glass in the lamp above them and by green paint upon the boxes themselves, to distinguish them from fire signal stations. Green has come to be regarded as the police color, just as red is the color of the fire department. These boxes differ slightly in appearance from the fire alarm boxes.

The doors are oval or monitor shaped. This style was adopted beause the roughs, who promptly recognized the innovation as their worst enemy, smashed in the doors of the first boxes, which were made flat. The new doors are guaranteed to resist successfully the most persistent assaults with brickbats or other weapons. Each box door has two keyholes, one at the bottom for the insertion of the citizens' key, so called, and the other smaller and in the usual place for the use of the police. The citizen's key does not open the door at all. It simply transmits when turned a hurry up signal for the patrol wagon. The citizen's key cannot be withdrawn after being used until released by opening the door with a policeman's key. Of course, all citizens' keys are numbered and registered, and improper use of them is thus effectually guarded against.

The signal system consists of three distinct and noninterfering methods of communication, automatic and manual signaling from the street stations to the station house, automatic and manual signaling from the station house to the street stations, and telephonic communication between the street stations and the station house, and *vice versa*, and these are arranged to operate over a single metallic electric circuit to produce certain results and to reach certain desirable ends. The signaling from the street stations to the station house is further divided into two classes— alarm signals

comprising signals directing the station house to send the wagon or ambulance or to use the telephone, and "patrol" or "on duty" signals, which indicate at the station house the movements of the patrolmen over the territory under their charge.

The signaling from the station house to the street station is accomplished by the use of currents of electricity of a different character from those employed to signal from the street station to the station house, and they sound a bell in the street station to indicate the reception by the station house of an alarm signal, or to announce to the patrolman that the station house desires to speak to him by telephone. The telephones are inductively connected with the circuit, and they are so arranged with relation to the signaling part of the system that conversation may be carried on between two or more points, signals may be sent from a street station to the station house, and from the latter to the former, all simultaneously over a single wire without interference.

When a signal box is opened there are exposed to view a dial and pointer, a hook in the center similar to that in a fire alarm box, a telephone transmitter and telephone receiver. Upon the dial are inscribed five signals which can be transmitted automatically by setting the pointer over the one desired and then pulling the hook below. With the signal given by the citizen's key from outside, there are in all six automatic signals which can be sent in without using the telephone. These signals, as ordinarily arranged, comprise three on duty signals, one for the use of each of the three policemen who are on the beat during the three divisions of the day, a policeman's wagon call, and a telephone call. Behind the apparatus in view is a gong to sound any signals which the station house may desire to send back to the policeman at the box.

The ingenuity of the system is perhaps most clearly demonstrated by the automatic distinction which is made between signals which go in merely as a matter of record, such as on duty signals, and those which require attention from the officer in command at precinct headquarters. On duty signals are automatically registered and automatically timed by the apparatus at the station house without sounding any alarm, or requiring the attention of the officer on duty there. But the moment a wagon call or a telephone call is sent out the receiving apparatus, besides recording it on paper, sets ringing an alarm bell which is not silent until the officer in command has responded to the signal, and has so signified to the person sending it by causing the bell in the signal box to ring.

Should the officer in charge at the station house wish to speak to the patrolmen on street duty, he can put himself into telephonic communication with them by manually sounding the gongs in the boxes whenever a patrol signal is received, or he can forestall the arrival of the patrolmen in turn at the street boxes, by merely getting a switch which causes an incoming patrol signal to automatically sound the box gongs and thereby summon them to use their telephones.

The receiving apparatus by which all this is accomplished at a station house is not complicated, and it can easily be understood after a few minutes' explanation.

A register and time stamp receive all the signals that come in from any of the twenty to fifty signal boxes in a precinct. These boxes are generally arranged on three or four circuits so that if a wire anywhere is broken, no more than one-third or one-fourth of the system in that precinct will be disabled. The disk telephone may be in an instant connected with any signal circuit or with the wagon house. Wagon calls that come in are automatically transmitted to the stable by setting a dial hand at the number of the box indicated and turning a switch. A bell similar to that in a fire engine house taps off the number and in a few seconds the wagon is harnessed up and is off. The signals are recorded on the station house tape.

The number of signals transmitted daily by means of Boston's system averages between thirty and forty from each box. A record is made of all of these.

All the members of the Boston police, the rank and file as well as the superior officers, speak in the highest terms of the assistance which the system yields them daily. Capt. Larry Cain, of police precinct No. 1, North End, related a dozen instances of the great aid given his officers by the signal system. "It was only last Saturday night" said he, "that there was an illustration of its value. The Friel and Dever family were fighting with axes and pitchers when Officer McCauley got on to the row. He could not arrest all three single-handed, so he rang for the wagon. When he heard it coming, he corraled all three of the fighters and got them to the station without any trouble. Then Detective Johnson had an experience the other day when he got on to those two burglars who had stolen a lot of watches in Fitchburg. He arrested one and conducted him to the signal box. The other thief followed, threatening violence. Johnson could not take both, for fear that in a scuffle both would get away. He rang for the wagon. When he heard it coming he grabbed the second fellow, and, despite his struggles, held him until the wagon men came to his assistance. He got both men and several hundred dollars' worth of watches. I could relate a hundred instances of the great value of the system, and we could not get along without it."

The Gamewell system is indorsed with equal fervor by the police of Chicago and other cities where it is in use. Another innovation which this company has recently adopted is a "visual signal," so called, a semaphore by day and a flash light by night, which is shown above a signal box in order to attract the attention of a policeman before he reaches a box, when his superior officer desires to communicate with him. Still another practical annex to the system is a small signal box specially constructed for private residences, banks, hotels, or business offices, to be connected directly with the system. When a signal box is placed in a private residence, a key of the house is left at the station, under seal. In case the occupants of the house have occasion to call for assistance of the police at any time, they can do so by simply pulling the lever attached to the box, and they can also indicate the nature of their want by using any of the different signals, that is, they may indicate burglars, drunken servant, fire, etc. When a call is made the occupants of the house can, if desirable, remain quietly in their bedrooms, while the policeman answering the call takes the key of their house from its place, and, having reached the house, steps quietly in at the front door to the utter surprise of the thieves or burglars, who find themselves absolutely trapped.

Such are the advantages in the way of additional security of property and life which the people of other cities have secured in advance of New York. The time is not far off when New York will have them too, but there is no excuse for longer delay. At least six hundred police alarm stations should be established in the streets of the metropolis, and every precinct should be fully equipped with the best apparatus for adding to the force the best auxiliary the policeman ever had. Then New York can indeed boast of the finest.—*New York Sun.*

THE PHONOPORE.

A MARVELOUSLY ingenious bit of apparatus is that described below. Apparently complicated, yet decidedly simple in detail, it is intended to serve as an adjunct means of telegraphing over a line already in use, and as a matter of fact it permits an ordinary telegraph line to be duplexed with great simplicity, and with the additional advantage that two messages can

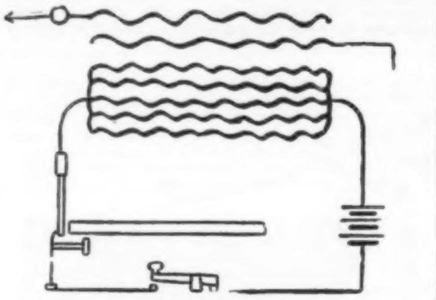


FIG. 1.

be transmitted over the same line in the same, as well as in the opposite, direction. It is the invention of Mr. Langdon-Davies, who was led to its invention by the disturbances often experienced on telephone lines, even when cut off from earth.

The system consists essentially of sending rapidly vibratory induced currents over a telegraph line already in use, and then employing these currents to operate a special relay working an ordinary Morse or other receiver. So far as the vibratory currents are concerned the line is completely insulated, the induction being produced by a special coil in a circuit containing a vibrator.

The phonopore transmitter consists of a circuit containing, first, what Mr. Langdon-Davies calls the phonopore; second, a vibrating reed to produce the oscillations of current desired; and, third, a Morse key. The phonopore itself consists of a primary coil built up of a number of distinct coils connected in multiple arc, and all wound upon an iron core; around this multiple helix is coiled a pair of secondaries insulated from each other, one end of each being left insulated, the other end being connected respectively to line and to earth. Depressing the key starts the reed in the phonopore circuit into action, and produces very rapid induced electrical oscillations on the line.

These are of but small intensity and produce no effect on the ordinary telegraph apparatus. Fig. 1 shows this arrangement in diagram, and displays the method of its operation. The vibrating reed is tuned to a definite and very high pitch, and is not directly attached by the long magnetic core shown, but forms a prolongation of the armature proper. This device secures a regularity that is otherwise hard to attain. The receiving station is shown in Fig. 2. The receiver consists in general of a soft iron core, upon which are wound two helices, one connected through the line with the transmitting instruments at the distant station, while the other is part of the local circuit, including a battery, galvanometer and a relay.

The current passes also through a contact formed by the vibrating reed tuned to the same period as the transmitter and another contact piece supported on a weaker vibrating spring of slow period. When the reed is at rest the contact between it and the vibrating springs is closed, and the local circuit magnetizes the core and thus attracts the reed to a position of equilibrium. If now the pulsatory current of period synchronous with that of the reed comes in from the sending station, the reed will be thrown into violent vibrations, and in so doing it will strike the contact pieces on the weak spring which forms part of the local circuit, thus breaking the latter and throwing the relay into action; this in turn transmits its signal to an ordinary telegraph sounder. Thus at each depression of the sending key the reed is thrown into vibration until it opens the local circuit through the relay. A single impulse, particularly if of period not coinciding with that of the reed, will not operate the receiver, which hence is entirely independent of the ordinary telegraph instruments on the same line. It might be supposed that an appreciable time would be taken in building up the vibration of the reed until it actuates the local circuit, but as a matter of fact the oscillations produced by the transmitter are so rapid that the action is practically instantaneous.

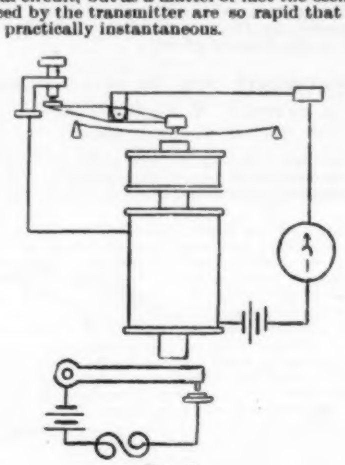


FIG. 2.

Fig. 3 shows the phonopore installation ready for use. It consists of a transmitter, a receiver, and an ordinary sounder or printing instrument. The phonopore system being entirely independent of any ordinary telegraph currents on the same line can thus be used to duplex ordinary lines with entire success. As a matter of fact, recent experiments in England gave good results over a distance of more than 100 miles, the signals being recorded on a Morse printer, although they were transmitted in both directions along a line that was constantly carrying the busy traffic of an important railway service.

Unlike the ordinary duplex systems, a line fitted with the phonopore permits the sending of two distinct messages simultaneously in the same direction, as well as in opposite directions. Its scope of operation is not limited by the distance just mentioned, for experiments in Spain have been successfully carried out over a distance of more than a thousand miles. The phonopore system is certainly a wonderfully ingenious one, and promotes good results in the hard test of everyday practice.—*Electrical World.*

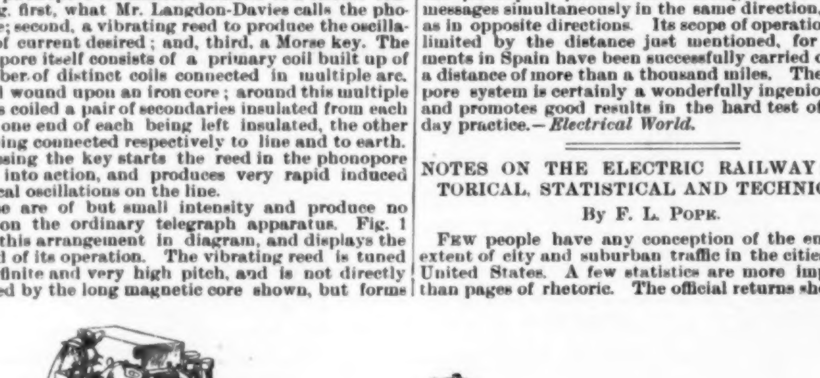


FIG. 3.—PHONOPORE INSTALLATION.

NOTES ON THE ELECTRIC RAILWAY: HISTORICAL, STATISTICAL AND TECHNICAL.*

By F. L. POPE.

FEW people have any conception of the enormous extent of city and suburban traffic in the cities of the United States. A few statistics are more impressive than pages of rhetoric. The official returns show that during the year ending Sept. 30th, 1889, the 110 street railways in the State of New York carried over 686,000,000 passengers, or 100 times the total population. In New York city alone the surface and the elevated roads carried together about 400,000,000. In Boston 100,000,000, and in Philadelphia 150,000,000 passengers were carried. In fact, statistics indicate that the street railways of the United States carry something like twice as many passengers as all the steam roads, and moreover it has also been found that the number of passengers increases from year to year in a much greater ratio than the population, which means, not only that more people ride, but that the same people ride more frequently each succeeding year.

The transportation of this enormous number of pas-

* Abstract of paper read before the New York Electric Club, Jan. 22, 1891.

sengers, probably not less than four or five billions, taking the whole country together, with safety, comfort, speed and economy, must be recognized as an undertaking of the most gigantic description. It is well worth our efforts to carefully consider the best means by which it can be accomplished. No work has ever been done by the inventor, the engineer or the electrician of such immediate and direct benefit to the masses as that which has to do with the subject under consideration.

Mr. Pope here dwelt briefly on the nature of the three methods of overhead, conduit and storage traction, and then in a very interesting manner gave the details of the work of Thomas Davenport and Page, exhibiting a copy of *The Electro-Magnet*, a little weekly paper printed by Davenport in this city just fifty years ago. After pointing out the impossibility of achieving any great result with chemical batteries as the source of power, Mr. Pope came to the invention of the dynamo, the discovery of its reversibility, and the dawn of the modern era of electric power transmission. He then called attention to the very early work of Stephen D. Field, and to that of Joseph R. Finney, who brought out his overrunning trolley at Pittsburg in 1882. Mr. Field had in his original plans proposed the use of a conduit, and that method was to-day being eagerly pushed to perfection.

Mr. Pope then dwelt upon the many desirable features of storage traction, but showed that the main objection was a financial one, a storage car mile costing 10·6 cents, or about the same as horses, while the overhead system reached only about 5·09 cents per car per mile. As to the results of storage battery operation, Mr. Pope reviewed the expert tests made by himself in 1886, for President Whitney, of the West End road, of Boston.

Coming to the question whether electric railways are dangerous, Mr. Pope said:

With a view of getting at the actual facts in the case, the *Boston Advertiser*, a few months ago, sent out a circular letter asking information from every city in which electric railways are in actual operation, from Portland, Me., to Galveston, Tex. It was asked what system was used in each place; whether there had ever been loss of life or injury from the wires; whether there was any serious objection on the part of the public to overhead wires, and what was the general opinion in the locality as to the effect of the introduction of electricity upon the street railway service. Replies were published from 64 cities and towns. All but four of them were favorable. Not one solitary instance of accident or serious injury from electric currents were reported. One of the objecting places was Newport, R. I., where it seems the "upper ten" strenuously opposed the introduction of anything that would popularize riding on the streets.

An extraordinary amount of nonsense has been printed and talked in respect to the alleged dangers of both electric light and railway wires. The public have been needlessly alarmed by the exaggerated statements of interested parties, but, nevertheless, the danger is so small, as a matter of fact, that the actual figures are almost astonishing. Most of the accidents which have been reported occurred in New York city. Yet the statistics show that in 1889, out of 1,467 deaths in New York city, by accidents of various sorts, only *nine* were due to electricity, a considerably less number than were killed by being run over by horse cars. Not a single death was recorded in Boston, although there are perhaps more wires there in proportion to the population than in New York. There are in the six New England States nearly 140 arc light stations, burning over 20,000 arc lamps and distributing 30,000 horse power of electricity through the streets of the principal cities and towns. During the last ten years, so far as I can ascertain, there have been but *five* deaths from electricity; four of these were employés of the lighting companies, and one was a careless boy who climbed upon a shed and took hold of a wire. During the same ten years the steam railroads of New England have killed 2,339 employés and 2,902 other persons! 5,241 against 5. Not only is electrical power for less dangerous than the same quantity of power used in other industries, but it is relatively safer, as the few accidents that do occur are among the employés. These remarks refer to electric wires in general. Now as to electric railway wires:

I believe it is an incontestable fact that not one single man, woman or child has ever been killed or even seriously injured by a 500 volt current, which is the highest pressure ever permitted upon electric railway wires. Every alleged case of accident by railway wires has, upon investigation, proved to be either without foundation, or to have been caused by an electric light current. When we consider that shocks have been experienced by men, women and children, persons of all ages and all sorts of physical conditions, sometimes for a period of several minutes, experience seems to warrant the positive assertion that the electric railway current is not dangerous to human life, and that we may dismiss that question from further consideration.

Many persons are alarmed at the vivid flashes of light which are often seen at night beneath the wheels of an electric car, and at the point of contact of the trolley wheel with the overhead wire, and are under the impression that they must indicate a very dangerous electric pressure. Such, however, is not the case. In an electroplating establishment at Ansonia, Conn., I once saw a workman accidentally set a tin pail filled with water upon a pair of electric conductors near the dynamo. The pail instantly disappeared, being not merely melted, but being converted into metallic vapor, with a terrific flash which illuminated the whole building with a dazzling and instantaneous radiance; yet the current which produced this startling phenomenon was of such low pressure that it was impossible to detect its presence by the sense of touch, even by applying the hands directly to the bare conductors.

The average speed of the horse car is about six miles per hour. The question is sometimes asked: How fast may electric cars be safely run in a city street? One fact within my own knowledge will go far to answer this question. There is a heavily traveled street in Pittsburg only 36 feet wide, containing a double-track cable road, which leaves not more than nine feet space on each side. At first the cable cars were run at the rate of seven miles per hour; afterward the speed was increased to nine and one-half miles per hour. The records show that there are not so many accidents under the present arrangement as there were before. Pedestrians and drivers are more careful and take fewer chances. The schedule rate of the electric cars in Cleveland is nine miles per hour, and in some parts of Boston as high as 12. The value of an electric railway to the public is largely determined by its speed, but the economical aspect of the question is equally important. If we make six miles per hour with horses and nine with electricity, each car does 50 per cent. more work without increased expense for conductors' and drivers' wages, which is an important item. Another economical feature due to the use of electricity is the ability to haul one or even two cars without loss of schedule time on special occasions when the traffic is unusually great.

Nothing is more astonishing than the capacity of the electric cars to make their schedule time in the face of the heavy storms of a New England winter. It is a common sight to see an electric car running apparently with perfect ease up a heavy grade through snow a foot deep, pushing or pulling other cars loaded to their utmost capacity.

The total number of electric cars now running in this country is probably between 2,500 and 3,000. Of the whole number, I presume not more than 30 or 40 are operated by storage batteries. The fact that the overhead system, though introduced at a later period than either the storage system or the underground distribution system, has so far surpassed them both, goes far to show that as yet it is the only system which has been able to meet the various exacting requirements of our street railway service.

Mr. Pope then spoke in terms of praise of the work of C. J. Van Depoele, Leo Daft, and F. J. Sprague, and closed as follows:

The limits of time compel me to content myself with the briefest possible reference to the most important development of electrical transportation which has yet come before the public, the electric underground railway. This undertaking having been placed in the hands of electrical engineers whose competency cannot be questioned, and backed by ample capital, has proved in London a phenomenal success. We are now assured that a syndicate of the most prominent capitalists of New York have undertaken to establish a system of transportation upon the same plan, consisting of a network of tunnels at a depth of 100 feet beneath the surface, and connecting all important points not only in the city itself but in the adjacent sections of Long Island and New Jersey. In such a system it necessarily follows that the train must be run by electricity to the exclusion of any other power.

Every thoughtful person realizes that something must be done at once, not only to relieve the congestion of traffic which already exists in the streets of New York, but to provide for the enormous yearly increase which must be taken into the account. Statistics show that the traffic of the horse cars and elevated lines in New York has increased 46 per cent. within the five years from 1884 to 1889. A careful estimate which has recently been made of the movement of passengers in and about New York during the year 1890 gives the following amazing results:

New York City (surface and elevated roads)	400,000,000
Brooklyn bridge	38,000,000
Long Island ferries	90,000,000
Staten Island and New Jersey ferries	85,000,000
Total	603,000,000

If the profit derived from carrying these passengers amounts to only one cent each per trip, it nevertheless figures up to the snug little sum of $6,000,000 per annum, which makes a very comfortable dividend upon a capital of $100,000,000. Such a system would admit of the running of solid trains at very short intervals through the city, to and from all points in the suburbs, in every direction, and I venture here and now to predict that within the next twenty years, if not the next ten years, electrical underground transportation will be brought to such a state of perfection that a passenger entering one of the central stations of New York may be deposited at his home station at any point within a radius of 10 miles in fifteen minutes time, and at a fare of five cents. And this magnificent result is to be the contribution to the convenience and prosperity of the public of the electrical engineer.

[Continued from SUPPLEMENT, No. 795, page 12697.]

THE BUSINESS END OF THE AMERICAN NEWSPAPER.*

By A. H. SIEGFRIED.

THE second and, taking the country over, the larger source of newspaper revenue is advertising. *Printer's Ink*, a weekly paper wholly and intelligently devoted to newspaper advertising, estimates that the total amount spent for advertising space in America is in excess of one hundred millions of dollars annually. My friend, Mr. S. C. Williams, Eastern business manager of the Chicago *Evening Journal*, who has given discriminating study to the subject, estimates that the newspaper advertising done in this country each year equals $2 for each unit of our present population, that is, about $125,000,000. One advertiser is upon record as having spent within one year $750,000 for his own advertising, and at least two score spend from $250,000 upward. It is probable that the general advertisers in the United States who spend $50,000 or more each year upon this means of trade stimulation would more than fill every chair in this room, and yet there remain $75,000,000 or more which are paid by the small space buyers to small and great publications scattered through almost every county in the Union.

The larger number of general advertisers conduct this feature of their business through general advertising agents, who, both as counselors and brokers, act as middlemen between space buyers and publishers. The first of these general agencies was established in 1828, while now there are in this country about one hundred and ten, large and small, though the great volume of the business is in the hands of less than a score of agency firms. Some of these employ large capital and clerical forces, and conduct a business which runs into hundreds of thousands, and in some few cases into millions of dollars annually. A few of the great advertisers, such as C. I. Hood & Co. and the Royal Baking Powder Co., conduct their own advertising under heads of thorough expert knowledge and of fine administrative ability, who employ from thirty to fifty clerks, preparing copy making contracts, and watching the execution thereof so thoroughly that in an annual expenditure of half a million dollars the right or wrong earning of each dollar can be unerringly traced and confirmed.

A remarkable feature of this great division of the publication business is that probably no two distinct publications on earth work on exactly the same basis as to prices and methods. All conduct their business within certain widely separated lines, but it remains that among the 17,760 publications there are 17,760 methods of business in which no two of them exactly agree. Another remarkable thing in it is that the expenditure steadily increases, that the majority of the publications get on fairly well, and that not a few of them are growing rich by a net increment of from $500 to $1,000 each day.

Nor are they who pay the money for newspaper publicity more systematic, for each advertiser has his own peculiar method for estimating space values and for depreciating quantity and quality of circulations, as well as his own plan for conducting this part of his business. The one thing upon which space sellers and space buyers do agree is that newspaper advertising is the salt of the earth.

Primarily, a newspaper should be made, up-stairs and down-stairs, with no manner of thought except as to its readers. Secondarily, a newspaper thus conducted becomes, in the very nature of the case, invaluable to the advertiser.

Yet the smallest number of either publishers or advertisers ever see the absolute value of this plain principle in newspaper business ethics, and so the daily and nightly fact is that the average publisher is always yielding and truckling to the advertiser, and that the aggressive advertiser is forever demanding some new concession which, even in his own interest, if he could but see beyond the shadow of his nose, he ought never to want. No good can come of this line of discussion unless it be candidly admitted at the outset that flagrant disregard of the newspaper reader and greed for gain from the newspaper advertiser have blinded all parties in interest as to the true office of newspaper publication, to the true source of newspaper power and to the true basis of newspaper value. Passing by whatever of wrong tendency or work there may be in the editorial rooms, the business department itself, in its own interest, should not only refuse to allow the reading columns to be encroached upon or subordinated to business demands, but the advertising columns themselves should be guarded as by walls of granite and gates of steel against advertisements which are deceptive, fraudulent, indelicate, immoral, or which offer immunity from the results of immorality. And yet it is true that, so far as I know or have been able to learn, there are only nine of the prominent daily newspapers in the United States which consistently and persistently follow this high line of business conduct.

Most publishers do, but none ever should, admit a line of reading into reading columns which is paid for, and which is intended to appear as if written or selected by the editorial department on its merits as reading matter, while it is really intended to serve private business interests, unless such matter is in some way, either at its beginning or end, distinctly marked as an advertisement. Mr. Charles A. Dana has been somewhat quoted in support of this idea, and is thought by some to have been its author, but it originated outside and before the New York *Sun*, and is enforced more rigidly by certain other papers than by Mr. Dana's well conducted journal. Any other method concerning paid reading matter is a fraud upon the reader, because it is meant to carry to his mind not merely publicity for a private business purpose, but to impart to such matter the added force and validity of the apparent favorable opinion or indorsement of that department the office and duty of which is to write and select none but matter inherently interesting, informing, or instructive, absolutely apart from any other idea whatsoever. No one particularly objects to being advised in a small paragraph at the foot of a reading column that Brown's troches are sure to do their perfect work upon hoarse throats, or that Hood's sarsaparilla will purify totally depraved blood at the rate of one hundred doses for one dollar, provided the reader is fairly advised at the outset that his eye is about to invade an item published in the business interest of and paid for by John I. Brown & Sons or C. I. Hood & Co., estimable and honorable men, whom, under the correct method I have indicated, I am frank to say that I highly esteem daily, except Sunday, at the rate of $1.75 per line. But what shall be said when in the midst of reading matter, in conspicuous and seductive head lines, followed by a quarter column set in the regular news type, a surpassingly interesting story or the moving recital of a striking incident entices the reader line by line down through an article placed before him on an honor bright reading matter basis, until he brings up, unexpectedly and exasperatingly, face to face with Warner's safe cure or Duffy's malt whisky! And what maledictions shall be visited upon a paper which, under similar disguise and for the sake of money, gives sanction and validity to the schemes of business deception and financial fraud, which are almost every day seeking to filch unrequited hard cash from honestly filled pockets? More's the shame, not merely secular newspapers, but powerful religious journals do hunger after and fatten upon this sort of tainted food. I am not moved to this expression of views entirely by regard for newspaper business honesty and for the rights of newspaper readers, but the plain dollar-and-cent, common sense fact is that the contempt, irritation, and resentment of readers thus played upon reacts against both newspapers and advertisers who seek gain from such trickery.

Another evil in the space selling part of the newspaper business is the subordination of the rights of the reader, without whom there can be neither newspaper nor advertising, by distributing all manner of displayed advertisements through tops and bottoms of reading columns, to such an extent that what the publisher owes to the reader as a solid page or part of a page of reading, assumes the appearance of an incipient checker board. A year ago this month the

* A recent address before the Outlook Club, of Montclair, N. J.

notable political struggles at Albany and Washington, and the wrecking of three New York banks by Claassen, Pell, Simmons and their gang, were commanding subjects of popular interest. On a certain day when these events were at their climax a leading New York paper gave exceptionally thorough and well prepared reports of them, but intermingled with those reports were eight displayed advertisements, each of from 2½ to 9 inches of space, one placed at the top of a column, another at the bottom, and so on through the page, so that reading matter surrounded each advertisement on either two or three sides, and this valuable and expensively prepared matter, written for public interest and information, was impertinently encroached upon and offensively subordinated to such an extent that 286 inches of it was completely dominated by 30 inches of pills, and balms and plasters and dry goods. And this instance is a fair type of that constant and increasing subjection of the business end of it to money greed which has become an affront to and a fraud upon all who buy papers so gratuitously and offensively degraded. It amounts to a practical confession of weakness in respect to the actual value of such papers to advertisers, and it is an abject surrender of the legitimate purpose and office of a newspaper that is wrong in itself and damaging to the mutual interests both of those who sell and those who buy advertising publicity.

But beyond these and kindred evils at the business end of the newspaper, there is another which is a sin, and which ought to be declared a crime by every statute book. It is the publication of advertisements which while they set forth their apparently disinterested benevolence in technical truth are really untrue, and result in deception, such as those of the something-for-nothing petty scoundrels who work the ever gullible public under the general designation of "novelty" dealers; or of advertisements which defraud, such as the specious land enterprises, illegitimate mining schemes, guessing contests, lotteries and all the other related abominations; or of indelicate advertisements which I cannot here describe, but which are a shame to any newspaper and a pollution to any household; or of medical advertisements which covertly or openly offer immunity from the results of immorality; or of that class of advertisements which, chiefly on Sundays, in three leading and largely read papers in New York, one in Boston, one in Cincinnati, two in St. Louis and two in Chicago, practically constitute an exchange for the vicious. Before an audience such as this, close particularization of this stain upon daily newspapers and this menace to society is impossible, but here are real and recent samples of the despicable goods.

[Here the speaker exhibited recent copies of the New York *Herald*, *World*, and *Morning Journal*, with their "personal," "matrimonial," and "medical" advertisements colored in red ink.]

A few years ago one of our village clergymen got to himself censure from the few, but gratitude from the many, because of open and specific denunciation, in one of a series of Sunday evening lectures to young people, of the attempt of a firm of unprincipled scoundrels who had settled right here in our own streets to befoul the young of our village with vicious literature. He told us that but for the postmaster then in office, who stood between our children and a flood of moral and intellectual pollution, the intended mischief would have been accomplished. A few of our transcendental pietists said of the clergyman that he had better been preaching the "simple gospel." But I tell you, out of what I knew then and what I have learned since, that no better or truer or timelier gospel was ever preached on this mountain slope, and that no more useful works were ever wrought in defense of our homes than the gospel that was then preached and the thing that was then done by Dr. Bradford and Mr. Sandford. But our pure minded people neither knew nor realized the truth which moved that Sunday evening's invective, and now, as then, few of you realize the facts behind and embodied in that more insidious and wicked agency which lurks and works among us, and all over this land, through a few of the Sunday newspapers, an agency which does not threaten the young alone, but which invades and sunders many a home.

In the same year that our home clergyman and postal official did us the incalculable service I have named, I, for a purpose wholly apart from theirs, and, at the time, ignorant of it, was making an exhaustive study of the phase of newspaper advertising I am now denouncing. At that time only one paper of 100,000 circulation, and to the extent of but half a column each Sunday, was engaged in this infamous business, but investigations based upon one issue of that paper —a paper which comes regularly and came to-day into scores of Montclair homes and business places—led straight to five towns in New Jersey, and Montclair was one of them.

Last Sunday (I am not beating the distant and empty air, friends)—*last* Sunday, *three* New York papers, having a joint circulation of half a million copies, spread over the country 2½ columns of these signals and beckonings of infamy, while newspapers in Boston, Chicago, St. Louis and Cincinnati contained six columns more. You who have seen in these advertisements only the silly sentimentalities of idle fools may, if you wish, learn the terrible truth. The men who receive these things know their meaning. Every policeman, from the superintendent in his arm chair down to the patrolman in the street, in New York, Boston, Cincinnati, St. Louis, Chicago, and the other great towns knows it. The officers of the Society for the Suppression of Vice either know it or confess themselves dolts. The agent of that society, who is not slow to attack vice in other forms, knows it. Why shall not an informed and resolute public sentiment be made to see it, and know it, and down it? You think me vehement, extravagant, possibly inapt, as touching this business crime of certain American newspapers; but I tell you, knowing the truth whereof I speak, and measuring the words wherewith I express that truth, I tell you that these departments of these newspapers are paths for the tread of devils, and that their steps take hold on the streets hard by our own homes.

Let me finally and briefly speak concerning the relation of the newspaper to things social, moral, and mental, touching it at only two points, the village paper as related to ourselves and the general newspaper in its own broader field.

It is often the thing here, as everywhere, to speak of the village weekly depreciatively. The thoughtless but often heard expressions concerning it are: "There's nothing in it." "What a stupid thing it is!" "What upon earth did he put this in for?" "Why under heaven didn't he leave that out?" "I wonder if the thing is making any money?" "If it is, it doesn't deserve to!" and so on for quantity and to nausea. I believe I pretty thoroughly know the average village paper. I have an honest and inclusive respect for it, and as to our own representatives of it right here at home, I want to say, with no silly air of patronage, that it is greatly better than the average, the country over, and that we are fortunate that we have what we have. Neither you nor I always agree with it. A poor thing were it, and of little force were we, if we did. It has its weaknesses. Its alleged proof reading covers a multitude of fearfully and wonderfully constructed verbal and typographical eccentricities. It persists in styling us Montclair-*ites* (in general, adherents of a man or cause), when there is ready to its hand the more appropriate, smooth and musical name, Montclairians. Some such minor faults can be laid at its door. But it is a good gatherer of our home news and exponent of our home interests; it is fair to its opponents, and its facilities for publicity are open to them as to its own household; it has respect for its place among us, and dignity in its work for us; it abuses nobody; it honestly seeks to tell the truth, without distortion or sensationalism; in all its moral parts it is clean and pure, and it is never in line with those who seek to do evil; for all the workers and agencies of good it has an open door and an extended hand; all things considered, I do not know a better anywhere, and I do not believe you do. All the same, and considering the whole thing from a purely business standpoint as related to the mutual interests of both the village paper and the village people, I do not believe in more than one paper in so small and exceptional a community as ours. If this opinion be well founded, the inevitable consequent opinion is that in and for such a community the village paper should be non-political. In a village of homes, to which we gladly come from the frictions and self-seekings of politics and of business, removed from any center of political action or machination, I can see no more place for a political paper of any faith than for an organ of the single tax idea, or of Calvinism, or of the Andover hypothesis, or of the apostolic succession. The purely local newspaper has nothing to do with the formation and shaping of general thought and opinion. The nature of its place, work and limitations obliges it to thrive upon, as it ought to serve, the interests and doings of a great family as a whole. It cannot at the best, and it ought not at the worst, be other than part and parcel of general and not of class interests; but the rather, because of the close contacts, direct relations and interdependence of village life, it should be always in mood and condition to enter into, shape and guide the unified elements and movements of such life. These are times when natural and providential trend is toward elimination of ism, ist, doxy, pathy, party and all the other barbed-wire lines of selfishness and separation. Let charity begin at home.

There is in every region like ours more than enough work fos the village newspaper without any visible consciousness of the existence of the nation, and only of the State in so far as the State has actual and tangible inter-touch with the village. We have a naturally beautiful, and a prosperous, cultivated, healthy and moral town, but it remains that we are a town cursed with one dominant natural advantage—that of our topography—and that our purely physical features have induced and impelled an aggregate growth and prosperity which have, by reflex action, held back works of taste, beauty, culture, comfort and necessity. Right here lie both duty and opportunity for our village press. Concerning these things it has right wishes and convictions; it often has stimulating paragraphs. It is open to the usually incoherent and ineffective though right-minded amateur contributor, and all that. But it is deficient in that sort of carefully thought-out, analytic, comparative, explanatory, inciting, argumentative and persistent editorial work needed to arouse, formulate and lead public opinion along that large line of concerted action without which we are in danger of becoming simply one of those little ugly, ragged, commonplace imitations of a city of which the country is already over full.

Please tolerate me yet a few moments while I lay out a full three years' course of work for our village press by hastily naming a few points upon which it ought to lead and teach our people constantly and relentlessly.

It should teach us, first and foremost, that by every indication of nature and every need for home life, no sins of omission or commission should be allowed which can impair or destroy, even in the remote future, the appearance or the reality of genuine country village life and character. We want to leave the city behind us at the North River.

It should lead in and strive for the formation of a fairly representative, advisory, watchful and influencing council or congress, which shall include wise and aggressive men from each city, town and township, from the north line of Paterson to the south shore of Newark Bay, and from the crest of the second mountain to the ridge line which passes through Rutherford and Arlington, to the end that there be concerted, discriminating, persistent education of the people, action by the people, and legislation for the people, bearing upon the sure preservation of the natural beauty of a matchlessly beautiful region, and upon those questions of water supply, sewage, sanitation, transportation, education, and all the rest, as to which there should now be unity of purpose and action before it shall be forever too late.

It ought to teach that our local method of property assessments is unjust and inequitable, and, as to our larger future, perilous, and that our unfair and inexact system of taxation is a relic of local economic tradition which does not in the least fit present conditions.

It ought to teach that our high school, embodying a corps of teachers which, in number as well as in individual and collective ability, is the equal of many an academic and collegiate faculty, and pupils who come from homes of a uniform comfort, culture and condition nowhere overmatched—that this school is housed in a building of structural unsafety, inadequate capacity, architectural ugliness, general and related inadaptability, and nerve trying, limb cramping, spine contorting and mind wearying mal-equipment, which hamper teachers, hinder pupils, create frictions, provoke irritations and develop misunderstandings that make life a burden to instructors, students, parents and trustees.

It ought to teach that a village library, now old enough to vote, and yet having but 1,500 volumes, and not because of volition, but because of conditions in the nature of the case controlling, is starving and dying when it ought to be vivified by endowment and housed in comfort, comeliness, and convenience.

It ought to teach that sewage, adequate, complete, and enduring, should without delay of a single year permeate and ramify every half acre of street and soil already sodden and saturated with poison which even now causes lively apprehension of the "pestilence that walketh in darkness, and the destruction that wasteth at noonday."

It ought to teach that roadways, hard, smooth and lasting, and reaching from curb to curb, should, instead of creeping along a few thousand feet each year, cover every even moderately traveled street with the utmost rapidity possible to large and not stinted use of money and men, and that, once laid, they should be unfailingly protected from the ruthless digger and ditcher.

It ought to teach and fight, not from any narrow motive of selfishness nor along any attenuated line of impracticable fanaticism, that whereas this is and of right ought to be a community of family and home life, we already have enough of the saloon; that in the future it shall diminish rather than increase; and that citizens who, even in a legal way, lend their names, influence or effort to perpetuate those we have or to add to their number, whether they are gin mills in Bloomfield Avenue and down at the "Ferry," or beer and wine selling cafes in that sort of a club which has already become the focus of our home and social life, that such citizens are at variance with the best interests of society.

It ought to teach that we do not need or want a park —localized or defined—but that every home now or ever to be anywhere within our outermost boundaries can be and should be part and parcel of our great park; that every piece of woodland, large or small, which has escaped the vandalism of the axman, should be cleared of underbrush and weeds, and made just such another arbor of native beauty as that which our town committee's chairman keeps as a public delight and example; that every vacant lot and open field should be made clean and tidy and kept so, and that every fence, wherever there is one, should be, as to construction and maintenance, a thing to please and not offend the eye; that the sparkling brooks in which we are so rich, instead of being a stench and a menace, should be trained, cleansed, turfed, rusticized and be made limpid delights, after the example already set by Mr. Wilson and Mr. Carey; that our lanes and streets, in each foot and yard of their length and width, should be smoothed and cleaned, and that it shall come to be felt a disgrace to allow them to be strewn with anything of litter or debris, or carelessly left in disorder after repairs or building; that the idea of residence flats is at war with country life, and that residences should be built so apart that sunlight and air and roominess may be between them everywhere, so greatly and widely that the mistresses may not gossip from window to window or the maids from kitchen to kitchen; that when lines of internal transportation come, as come they must, they shall bring no disfigurement or obstruction to our highways; that, scattered all through the town, wherever there is a triangular or other polyangular intersection of streets, as at Elm Street and Orange Road, at Fullerton and Gates Avenues and Orange Road, at Orange Road, Harrison Avenue and Union Street, at Church Street, Hillside Avenue and Valley Road, at each railway station, and like spots everywhere else, there should be little parks—turf, flowers, graceful lines, vases, statuettes—and that our central intersection, hard by, should be made smooth, hard and cleanly, and graced at its center with a perennial fountain, while from the sharp angle in front of the old church should rise a granite campanile, bearing aloft a chime of bells, whence at every sunset in summer and curfew in winter, as well as at the hours of worship, not sharp and disturbing clang, but softly musical old melodies shall wander along our slopes and echo against our mountain side; that nowhere shall public taste tolerate such stretches of unbearable and ineffable ugliness as offend our eyes and disfigure our streets in the collection of shanties at the Lackawanna station and in Bloomfield Avenue, above Willow Street; that, under ideas of which these points are mere suggestions, is the disclosure of park possibilities which are practical and comparatively inexpensive, and which would make this village an example to all the world outside of France, and a healthful and happy delight to all of us who here abide.

Finally, our home press ought to so teach us that all the old and often whine about Greenwood Lake railway bonds shall become a song of thanksgiving; that the first monument ever to be raised at any of our points of parkleted beauty shall be in honor of him whose foresight, enterprise and dogged persistence in building a competing line not only opened up to homes of beauty and culture the northern and eastern parts of our town, but through all these later years have ministered to our convenience and economies in a degree out of all proportion to original cost and subsequent burden; and that under laws already framed or yet to be secured, a fund ought now to be provided, placed in the at present hampered hands of our little village legislature, whose labors, wisdom and absolute integrity are our common gratitude, trust and pride, and through them be made to work out now, not in the long waiting future, but now, the comfort, the healthfulness, the convenience, the culture, the higher morality and the physical beatification of this one among the choicest regions which nature has given for homes of men.

Now, turning quickly away from home, and back to the American newspaper in the large, let me say one word which I hope shall leave it yet higher in your estimation and firmer in your regard. I have not hesitated to criticise it at points where it is vulnerable, but I do glory in that larger and broader view of it which I know is justified by what warms its heart and moves its activities. Let me remind you that on its aggressive side, as related to practical moralities and movements,

in the line of discovering, exposing, strangling and driving to the wall vices and corruptions, which seem at times to be a load too grievous to be borne, but too weighty to be removed—say what you will of the often viciously impure, scandalous and demoralizing tone and contents of a portion of the press—there do come occasions when the best religious and moral organization falls short of the end, and the facilities and power of the newspaper come in to do indispensable work on its own account, or to prepare the way for and co-operate with the gentler forces. There do come times of moral sultriness and miasma when purity and healthfulness are only possible after the cyclone's whirl and the tornado's blast. Do not forget that the old Tweed ring was damned, downed and driven out by a New York newspaper; that the Ku-Klux of Kentucky were discovered, hounded, corraled and destroyed by the democratic Louisville *Courier-Journal;* that the gamblers of Louisville, stronger and bolder than in any other American city, and even respected by a considerable part of the population, were driven out and have been almost kept out of their dens by the Louisville *Commercial;* that when a New York policeman, sworn and set apart to protect virtue, assailed it and outraged society, and systematic and powerful efforts were made to hide the crime, buy off and drive off witnesses, and delay and hinder the natural course of justice by all manner of evasion and technicality, a New York newspaper, quick to see the crime and its demoralizing police influence, and the trend toward obstructing law and justice, threw detective skill and journalistic force into the fight, aroused right sentiment, aided the prosecution, and landed the official scoundrel and personal criminal in Sing Sing for eighteen years; that the most daring, cunning and powerful ballot box stuffer and municipal political corruptionist in America—Mackin, of Chicago—who had come to open pride in his unholy political power, who could make or unmake majorities, control courts and police, who was feared by his enemies and dreaded even by the friends who had to use him, was pursued by a Chicago newspaper for eighteen months against all the odds, through all the intricacies and over all the obstacles that men, law and lawlessness could devise and money buy—but at last the newspaper locked him inside the State prison; that the moral bluntness, bribery and corruption there were in telephones and surface railroads five years ago were at last investigated, rooted out and punished—not by public sentiment alive and alert of itself, but stirred, and poked and prodded and walked up and down like a man in an opium stupor, first by the press of New York, and then, when it was once aroused, by that of the whole country. And these are but examples of a hateful and uncanny work that no one wants to do; that the religionist and moralist cannot do; that something or somebody must do, and that the press *does*, not always nor often because it wants to, but because no one and nothing else will do it, and because by virtue of its pluck, power, facilities, responsibility, and at the last its honest and earnest care for good against evil, and for right against wrong, it is sure to get into, and usually on the right side, of every great fight.

And then, on the sympathetic side, remember that the press, in one way or another, is with us always. In trade, manufactures, commerce, the professions, the household, every day and almost every hour it touches in some way our buying, selling, spinning, weaving, digging, delving, reaping, mowing, sailing, carrying, traveling, building, writing, arguing, teaching, healing, pleading, singing; while as to our inner life, hand in hand with the author, the preacher, the prophet, the evangel, often unconsciously to us, but ever surely in some way and somewhere, it is with us as we fear, as we repent, as we pray, as we aspire, as we hope, as we believe in that immortal life at the threshold of which we shall leave behind us the intelligence of the printed page, and enter into that higher something which now we know little of, save that it will be impact of spirit upon spirit, and eternal jointure of spirit with the divine and the infinite.

JUBILEE OF THE CHEMICAL SOCIETY OF LONDON.

The celebration of the fiftieth anniversary of the foundation of the Chemical Society commenced on February 24 in the theater of the London University. The meeting was worthy the occasion. The audience numbered about 400, and included many distinguished persons. Besides Dr. W. J. Russell, F.R.S., the president, and other office bearers on the platform, there were present Dr. John Evans, Lord Rayleigh and Professor Michael Foster, representing the Royal Society; Sir W. Grove, Sir Lyon Playfair, Sir F. A. Abel, and Sir H. E. Roscoe; M. Gautier, M. Combes, M. Haller, and M. de Clermont, representing the Société Chimique de Paris; Professor Will, representing the Deutsche Chemische Gesellschaft; Dr. Holtz, representing the Verein zur Wahrung Chemische Industrie, and Professor Victor Meyer. The Pharmaceutical Society was represented by Messrs. Carteighe, Bottle and Hampson, and Professors Attfield and Dunstan. A good many pharmaceutical fellows were present. The programme of the meeting was as follows:

1. Introductory speech by the President, Dr. Russell.
2. Address by the Rt. Hon. Sir Wm. Grove, original fellow of the Society.
3. Address by the Rt. Hon. Sir Lyon Playfair, original fellow of the Society.
4. Address by Dr. Longstaff, original fellow of the Society.
5. Presentation by Mr. R. Warington, of album containing portraits of original fellows and letters relating to the formation of the Society.
6. Address by Professor Odling on the development of chemical theory since the foundation of the Society.
7. Presentation of addresses from—
   (*a*) The Royal Society.
   (*b*) The Pharmaceutical Society.
   (*c*) The Société Chimique de Paris.
   (*d*) The Deutsche Chemische Gesellschaft.
   (*e*) The Russian Physico-Chemical Society.
8. Letters from foreign members.

DR. RUSSELL

opened his address with a passing remark regarding the weather—the dense fog having kept Dr. Longstaff away, and Sir W. Grove had not yet arrived. But there were others present who assisted in the formation of the Society. The Society, he continued, was the first founded for the study of chemistry. Hitherto chemistry and physics had been associated, but on February 23, 1841, twenty-five persons met in the Society of Arts, for the purpose of considering the advisability of forming a Chemical Society, and of these persons Sir W. Grove, Sir Lyon Playfair, Mr. Heisch, and Mr. J. Cock were still alive.

The president proceeded to describe the preliminary work of the foundation, remarking that it was the product of Robert Warington, and it was pleasing to him to think that the Robert Warington of to-day was one of their active members and a vice-president of the Society. (Applause.)

At this point Sir W. Grove arrived, and was received with hearty cheers.

Dr. Russell, continuing, said that he had done Sir William an injustice in attributing his absence to the weather. He then proceeded to sketch the condition of chemistry in the thirties and forties. There were then few public laboratories in England; indeed, Scotland was before it in that respect by several years. Private pupils were the rule, and when Graham came to London he received a few pupils. There was little encouragement to study the science, for people considered those who did so to be eccentric individuals. The College of Chemistry started in 1842, and was the first laboratory in London; there were others, and the Pharmaceutical Society opened one for its special branch in 1843. Dr. Russell, in rapid sentences, referred to the deplorable condition of experimental chemistry in those days, and then showed how Dr. Thomas Graham, Sir Robert Kane, and Johnston, of Dublin, each influenced the progress to better things. Faraday he did not claim as a chemist, for by that time he had entered upon his physical researches, which absorbed all his remaining years. It was in 1840 that Sir John Herschel began to make discoveries in optics which brought photography into the range of possibility. Herschel studied the dark rays of the spectrum which are chemically active, and demonstrated the property of hyposulphite of soda in fixing the silver reduction caused by such rays. Fox-Talbot's work was also spoken of, and that, too, of Robert Hunt; while it was mentioned that this is the jubilee year of Clark's soap test for the hardness of water.

Then, after reference to the curious scientific literature of 1841—one, Dr. Robert Rigg, having demonstrated to his own satisfaction that during fermentation of solutions, earthy and alkaline salts increase, and another, Brown, of Edinburgh, telling the Royal Society of that city how carbon may be transformed into silicon—Dr. Russell went on to speak of the discoveries of Dalton, Cavendish, and other famous chemists of the century, and traced the growth of interest in chemistry, attributing the start in this country to Liebig, who was the trainer of many of the founders of the Chemical Society. These references, concluded Dr. Russell, were merely the prologue of what was to follow, as the founders present would take up the story from where he left off.

SIR LYON PLAYFAIR

was the next speaker, and his first words were of the remnant of the old nobility of his science then present. It is a sad feeling, said he, that only three of the founders are now left among us. When they met in 1841 to form the Society, chemistry was being rapidly developed, rapidly evolved into definite shape. Organic chemistry was almost founded, and when he looked back upon the past, he felt that a few names would represent milestones on the path of progress. Then Liebig was *facile princeps*, the chemist of the world. (Applause.) Hofmann, his pupil, had scarcely risen on the horizon of the science. Kopp and Bunsen had published their first researches, but Wohler, the dear friend of Liebig, had already done much of his work, and Mitscherlich, whom he might call the aristocrat of chemistry, had enunciated his theory of isomorphism. Rosé, one the speaker's dearest friends, he mentioned as having made analysis beautiful; and others he named, including Rammelsberg, the physicist, to show what was going on in Germany then. France was not standing still. At that time a man who the other day was ancient was then a veteran—he referred to Chevreul. (Great applause.) His work was known to all interested in chemistry. There were Courtois, the discoverer of iodine, Dumas, Fremy, Pelouze, and Renault. These were the great luminaries in France. Whom had they in England? There was his old teacher Graham, in London (applause), Dalton, in Manchester, who had done so much by his atomic theory to place chemistry upon a higher platform; Faraday, the prince of electricians; his dear friend Grove, the author of the "Co-relation of the Physical Forces;" and Joule, who completed the mechanical relationship required to bring the two together. (Applause.) Fifty years was a long time in the history of an individual, but it was a mere mathematical point in a science, for although they considered that chemistry was of recent origin, he took it that the moment men began to study matter there was chemistry. It began with the ancient philosophers, such as Aristotle (applause), who speculated on elementary matter. Although chemists and microscopists were often twitted with paying attention to small things, as compared with astronomers, he claimed that chemistry had of recent years shown to astronomers the way to the constitution of the stars, and how new worlds are formed. ("Hear, hear," and applause.) Having said all this of the past, he would like to encourage them as to the future. Let them think, when they looked back on the fifty years, what chemistry might be at the end of a century. Analysis was leading to synthesis. They had doubts now as to the identity of the elements. They had to study the peculiar chemical transformations associated with physiological action. These and many more riddles were to be solved, such as the inner meaning of the periodic law and the motions of atoms. But there always comes a time in history when a man appears to revolutionize knowledge. There was a Newton once, and in the next fifty years there might arise a Newton in chemistry, who might discover laws of the affinity and motion of atoms, which would change the science as radically as Newton had changed their conceptions regarding the motion of worlds. Some of the young men present that day would see the chemistry of the future, and he fancied that they would look back and be surprised at the chemistry of to-day. He could not conclude more fitly than in the words of the poet:

> And men through novel spheres of thought,
> Still moving after truth long sought,
> Will learn new things when I am not.
>
> Thou hast not gained a real height,
> Nor art thou nearer to the light,
> Because the scale is infinite.

Sir Lyon Playfair resumed his seat amid great applause, and the President called upon

SIR WILLIAM GROVE.

There was in the audience a hush of that respect which civilization gives to old age. And here truly was a magnificent old man—one of the geniuses of the century. The great jurist and scientist has the appearance of a distinguished man. He is of Herculean proportions, and, though long past the allotted span of life, the shoulders are scarce stooped and the hand not palsied. He wore a suit of rough gray homespun, matching his iron gray hair. There is life in the old man, too; still plenty of the wit which one does not look for in a master of abstract science. He showed this in his opening sentences. "My qualification for addressing you," said he, is not one of great distinction; in fact it is that of old age, which has its privileges and its disadvantages. The former allows me to inflict myself upon you. One of the latter is the want of memory." Then Sir William went on to say that his main qualification for the position which he then occupied seemed to be that he was a survival of the unfittest; but he would tell them, as far as he could remember, what actually took place at the formation of the Society. Professor Graham was really the man who brought them all together. They were anxious to have Faraday as their first president, and he (Sir William) had gone and asked him, but, for some reason or other, he declined. At that time Faraday thought he would do most service to science by continuing the research in which he was engaged. So they had Graham for first president. The others who were associated with him he could not remember, but they would find them all mentioned in the charter; and now the only one he could recognize in the meeting that day was his old friend Playfair—clapping him on the shoulder, and adding, amid great laughter, "and myself." "Among my old friends," proceeded Sir William, "whom I am surprised not to find named among the founders, is

MY FRIEND JACOB BELL.

We used to meet in his house in Oxford Street, and he took great interest in all our work. He was a very good fellow, a man of culture, and a good chemist too. He was the man, you are aware, who was the means of introducing good, pure, unadulterated drugs into this country. I know his place well, and I spend four shillings in his establishment every year." This last remark created great laughter, and then Sir William spoke of Dalton.

He had heard him deliver the only lecture which Dalton ever delivered in London. It was at the Royal Institution, and was upon the atomic theory. His recollection of Dalton was that he was a man very much wrapped up in his subject, and his speech was unadorned but expressive. He recollected having seen, after the lecture, Dalton's drawings of his atoms. He represented them as spheres, and showed their union into molecules—I suppose said Sir William, you call them that now—his idea being that they economized space by being pressed into hexagons. Nitrogen, ozone, nitric acid, and another acid—he forgot its name—were represented that way. Sir William proceeded to speak of this in detail, apparently wandering a little, but the main idea was that Dalton thought atoms were symmetrical and tough bodies which could be compressed into hexagons. He regretted that Dalton had adopted the name "atomic theory." It was unfortunate to his thinking, because it simply meant a thing which could not be divided, and that was in a sense ridiculous. Although Sir William Thomson had measured an atom—not with a rule and compass—it seemed to him that the infinitely small was as absolutely incomprehensible as the infinitely great. (Applause.) He would have called the atom *minima*—if there is such a thing at all. Well, Dalton's law was the universal basis of the chemistry of to-day. He would not attempt to give a summary of what had been done in the science during the fifty years; it would take too much time, and would weary them—more so as it was all in the *Standard* that morning (laughter)—at least, some of it. Then Sir William went on to speak about the interesting and the practical in science. He liked the first the best, and told the meeting why. This took him into the region of science in which he used to work, and he mentioned that he ought to have discovered the spectroscope. He was working with the sparks of metals in the electric arc, and saw the lines. If he had had an ordinary amount of sense he would have thought what these lines were—the reverse of the solar spectrum. If he had he would have made the discovery instead of Herschel. (Laughter.) This reminded him of the man who found fault with the world, and who said that if he had been there at the time he would have made it a great deal better. (Renewed laughter.) In concluding the speaker said that he had been blamed for one thing—giving up chemistry for the bar. He was a barrister before he took to chemistry, although he had not a large practice; indeed, that enabled him to take to chemistry—(laughter)—but the fact was, he was influenced by an occurrence which frequently happened in nature—a large family. (Laughter.) In his career as a barrister—and he hoped an honorable one—(laughter)—he obtained what was wanted. In referring to the future of the Society, he suggested that the members should endeavor to prevent London fogs under a constitutional government, and amid great laughter and applause, Sir William Grove resumed his seat.

Dr. Russell thanked him for his address, and called upon

MR. WARINGTON,

who said that his father, the first secretary of the Society, had preserved the various papers in relation to the formation of the Society, and he (the speaker) had

had these collected, arranged, and bound, and it was now his duty to present the volume as a souvenir of the day. The letters were from gentlemen in reply to the circular which had been sent out. They were arranged alphabetically in the volume, and he had added portraits in platinotype of as many of the originals as could be obtained. There were seventy-seven original fellows. The album contained seventy letters and seventy-four portraits. Rather more than half of the portraits had been photographed by Professor Thomson, of King's College. Giving a rough analysis of the distribution of the seventy-seven original members, Mr. Warington said forty of them resided in London, fourteen in Scotland (eight of these in Glasgow), five in Lancashire, and the rest in Oxford, Cambridge, Durham, Newcastle, Belfast, Dublin, etc. All the teachers of chemistry in London, except the lecturer in the London Hospital, were there; and he mentioned also the different professions and industries which were represented by the original members, and the cordiality with which they all took the matter up.

Dr. Russell, in accepting the album, said that this most interesting and valuable gift would be placed with the heirlooms of the Society, and would be among the most cherished of them, while it would also be a permanent record of Mr. Warington's good feeling toward the Society, and of what his father had done for it. (Applause.)

Sir William Grove had not heard the remark about the photographs being permanent, and he rose to speak about that; but, the matter having been explained, he merely said that one can preserve photographs perfectly and permanently—at least, they had been good as long as he lived—by soaking them in mastic varnish, which gets into the photographs and protects the silver. It is not the surface varnish which does it, but the varnish in the paper.

PROFESSOR ODLING

was the next speaker, and rarely has one the opportunity of hearing such a discourse as the one he delivered. Exquisite in composition, with facts well marshaled, and each sentence showing intimate knowledge of the new chemical philosophy, the address will in the future rank as the feature of the meeting. Dr. Odling delivered it with excellent emphasis, and without notes.

The progress of chemistry during the last fifty years, he said, can only be estimated by the esoteric few. As doctrine and application go hand in hand, we find that the development of modern chemical industry is in a large measure the direct result of laboratory work. Industry, on the other hand, has offered to the science new and varied bodies in a most bountiful way, whereby the chemist has forced upon him a sense of the groundlessness of his deepest convictions regarding chemical constitution. But, putting them to the test of rigid proof, he would say this much of the chemical doctrines of the present—that they depend upon research having a wider basis than was apparent in the past. This was the proof that the deductions were better than w[illegible]fore obtainable. Black, the immediate predecessor of Lavoisier, had studied the effects of heat and mixture with the view of studying the arts and secrets of nature. Nowadays the arts have given us the means of unfolding many of the closest secrets of nature, for with the advance of synthesis—first worked upon by Wohler in 1854, and by Berthelot, one of their most distinguished foreign members, while other chemists have not hesitated to venture upon the work—such things as oil of wintergreen and madder were produced by processes of commercial synthesis which Berthelot practically opened up. When they thought of the work of Emil Fischer on the synthesis of sugars—(applause)—and many other processes, which time forbade him to enumerate, they felt that they must say "good by" to the old idea of vital force. For these synthetic bodies were a manifestation of the same mysterious force. He thought he might say that our ideas have not only undergone a change but a revulsion. Another set of facts, *pari passu*, was included under the theory of dissociation, identified with the name of St. Clair Deville.

In that Society they were not likely to forget that the most remarkable instances of dissociation were discovered by Sir William Grove (applause) who in an address to the British Association in '46, showed how the vapor of water behaved under the influence of incandescent platinum in the electric arc. Bunsen was also connected with that theory, and it all depended upon the law enunciated by Ampere and Avogadro. In the fifty years the theories of the solution of salts, of diffusion, of osmotic pressure, of electrolysis, had all undergone transformation. Graham throwing light upon osmosis and Faraday on electrolysis. Although Faraday had refused the presidency of their Society, owing to his connection with other branches of science, he had never lost sight of chemistry, and for many years he was a regular attendant at the annual meetings. Passing on to the study of matter at high temperatures, Professor Odling said that the research in this department of the science had enabled Bunsen and Kirchhoff in 1859 to discover spectrum analysis, by which chemistry was promoted from its merely terrestrial position to that of a cosmical science. How important, he said, were the advances which that discovery has produced even in our conceptions of the nature and mutual relations of the elements! It had enabled many chemists—several of their distinguished fellows—to enter upon the study of the nature of the elements, which in the future might lead to important truths, although at present they were not prepared to see clearly what the result would be. Then there was the question of combining ratios of the elements! How these are associated with each other was a matter which had been intimately studied during the fifty years, and the answer constituted the most characteristic advance of the period. If any one were to ask what was the great advance in chemistry during the period he would say that it was that; and he proceeded to epitomize the chief discoveries which had led up to the revolution of atomic weights the work of Gerhardt, Wurtz, Faraday, and others being mentioned. The great influence which their discoveries have exerted upon the development of the science, and their insistence upon the reacting weight unit being the same as the physical relative weights of the elements, were touched upon, and Professor Odling showed how the revision of atomic weights brought with it important alterations and conceptions regarding valency, replacing power, etc. Frankland's work having been referred to, he proceeded to speak of the periodic law, first discovered by Newlands—(applause)—but afterward more fully elaborated by Mendeleef, showing how the elements, previously considered isolate, were brought into kinship by virtue of their periodic functions. This conception was one of the grandest advances of the period, and it has opened the way to much more work of importance. It had enabled Kekule to formulate a law—based upon the knowledge of mutual saturation and acidities derived from a study of the paraffins, benzines, and similar bodies—which was the foundation of an entirely new view of organic chemistry. Then a phenomenon of distinct recognition was that of isomerism. It was thought when the word was applied to chemistry that it was an unfortunate selection, but the studies which were now grouped under it were the greatest triumphs of modern chemistry. Had time permitted, he should have spoken of the work of Lebel and Van 't Hoff, which was of immense value; and he should have had to discuss how these bore upon the original atomic theory of Dalton and the chemical theories generally which were accepted at the time when the Society was formed; but he had to content himself with mere references, although he felt sufficient had been said to show the nature and extent of the progress which the science had made since the Society was founded. (Applause.)

(*To be continued.*)

THE

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